ISECON '95

IS Education:

Meeting the Challenge of a Global Marketplace

November 3-5, 1995
ADAM'S MARK HOTEL
Charlotte, North Carolina

Sponsored by the DPMA Education Foundation

ISECON '95

PROCEEDINGS

IS EDUCATION:
MEETING THE CHALLENGE
OF
A GLOBAL MARKETPLACE

Charlotte, North Carolina
November 3 - 5, 1995

Joyce Currie Little, Editor

EDUCATION FOUNDATION
OF THE
DATA PROCESSING MANAGEMENT ASSOCIATION

DPMA

Association Of Information Systems Professionals
EDUCATION FOUNDATION

Dear Information Systems Educators

On behalf of the DPMA Education Foundation Board of Regents, it gives me great pleasure to welcome you to ISECON '95 here in Charlotte. This is a excellent opportunity to learn from and share resources with your peers.

The Conference Committee, under the chairmanship of Dr. Eli Cohen, has put together a great conference for you, which allows you to share in the latest thinking by the leading international educators. The education programs and Friday's workshops are among the best available anywhere and we encourage you to take full advantage of them.

While you are in Charlotte, I hope you will get caught up in the enthusiasm which makes this Queen City such an exiting place to visit. If you are a sports fanatic, you have come to the right place. From the NFL Panthers, the NBA Hornets, to the Charlotte Motor Speedway, this city creates excitement with a capital "E". If you are more into a relaxed mood try the Blumenthal Center for the Performing Arts, the Charlotte Symphony or the Opera Carolina. Of course there are the historic sites or just a leisurely walk into some of this city's beautiful parks. There is plenty to do for all.

Be sure to attend the Sunday luncheon at which we recognize the DISEA winner. This award, sponsored jointly by the DPMA Education Foundation and the DPMA EDSIG, annually recognizes the educator of the year. This event is a highlight of the conference, since the award recipient always has an interesting presentation and allows all of us to pay tribute to an outstanding individual.

All in all, the package provides a fantastic educational experience. The sessions are current and global in nature, with an outstanding keynote speaker, and a city that takes its hospitality seriously. The only thing left to do is for you to participate.

Enjoy and Welcome to ISECON '95

Best Regards

Leo C J de Folter, CMA
President,
DPMA Education Foundation
Board of Regents.

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WELCOME TO ISECON '95

"Meeting the Challenge of a Global Marketplace"

ON BEHALF OF THE DPMA EDUCATION FOUNDATION, welcome to the lovely city of Charlotte. Charlotte offers a splendid variety of entertainment, dining, and touring. It is yours to explore and enjoy.

While we can't do anything about the weather, be it good or bad, we do control today's climate. The conference climate is one of excitement, learning, and sharing.

Through your participation, this premier IS education conference is growing. ISECON '95 offers you 44 tutorial, workshop, panel, and paper sessions, three keynote speakers, many exhibitors, a conference proceedings, and several meals and receptions. This year for the first time the web provided you with information on keynote speakers, registration, schedule, and other important items of interest.

You will hear three vibrant keynote speakers. **Paul Gillin**, Senior Editor of Computer-world, kicks off the Saturday breakfast session describing the future for IS jobs globally. On Sunday, **Steven Gilbert**, Director, Technology Projects, American Association for Higher Education (AAHE) shares with us the results of research in how IS can improve instruction in higher education. Dr. **Milton Jenkins**, this year's Distinguished IS Educator, speaks on *The Continuing Impact of Technology on Education: Challenges and Opportunities* as part of Sunday's luncheon.

We have an absolutely outstanding group of exhibitors showcasing vital new texts, products, and services. These exhibitors will bring you up-to-date, answer your questions, and provide interesting ideas you can use.

Let us all applaud the great work of the numerous people who made ISECON '95 a reality. Many of their names are listed in the following pages. EDSIG, the educational special interest group of DPMA, provided a framework for these volunteers. DPMA headquarters staff, particularly **Sharon Barber**, is commended for her conscientious attention to the conference. They have all worked very hard to bring you the best ISECON conference ever.

Best wishes and *Let the Conference Begin*!

Eli

Eli B. Cohen

Conference Chair
ISECON '95
Charlotte NC Nov. 3-5
home page: http://info.acm.org/~Eli_Cohen/

ISECON '95

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ISECON '95

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	Roy Daigle, University of South Alabama

ISECON '95

TABLE OF CONTENTS

FRIDAY, NOVEMBER 3

WORKSHOP 9: 1:00 p.m. - 2:15 p.m.
Faculty Multimedia Development in a Windows Environment - A Discussion of Issues in Development and Delivery, William H. Moates, Indiana State University...p. 9

WORKSHOP 10: 1:00 - 2:15 p.m.
Developing Simulated Apprenticeship Units for Information Systems Courses, Arthur B. Kahn, University of Baltimore...p. 10

WORKSHOP 11: 2:45 p.m. - 4:00 p.m.
An Introduction to Windows '95/Office '95, Robert Grauer, University of Miami...p. 11

WORKSHOP 12: 2:45 p.m. - 4:00 p.m.
A Cultural Foundation for Maximizing Payoff from Information Technology, James K. Ho, The University of Illinois at Chicago...p. 12

WORKSHOP 13: 2:45 p.m. - 4:00 p.m.
Creating World-Wide Web Pages Using MS Word, Victor Barlow, Purdue University...p. 13

WORKSHOP 14: 2:45 p.m. - 4:00 p.m.
Introduction to UNIX for Information Systems Professionals and Educators, Daniel Farkas, Pace University ...p. 14

WORKSHOP 15: 2:45 p.m. - 4:00 p.m.
Using Humor in the CIS Curriculum, Denise R. McGinnis, Mesa State College...p. 15

SATURDAY, NOVEMBER 4

KEYNOTE ADDRESS: 8:00 a.m. - 9:30 a.m.
SPEAKER: Paul Gillin, Executive Editor
Computerworld
TITLE: Strange New World: The Skills Crisis in Corporate Information Systems...p. 16

PAPER SESSION 1: 10:30 a.m. - 11:45 a.m.

1. An Undergraduate Degree in Multimedia Design and Development: Collaboration between the Department of CS and IS and Art, Eugene G. McGuire, The American University...p. 17

2. An Innovative IS Curriculum Design: A Mixed-Mode, Phased Structure, Wanbil W. Lee, Lingnan College (Hong Kong)...p. 25

SUNDAY, NOVEMBER 5

KEYNOTE ADDRESS 8:30 a.m. - 9:45 a.m.
SPEAKER: Steve Gilbert, Director, Technology Projects
American Association for Higher Education
TITLE: If It Takes 40 or 50 Years Can We Still Call It a Revolution? Managing Transition: The Inevitable Integration of Information Technologies and Eduction...p. 260

PAPER SESSION 16: 10:00 a.m. - 11:15 a.m.

1. Client-Server Computing Technology: Past, Present and Future, Kevin McBride, California State Polytechnic University...p. 261

2. A Model for Integrating Client/Server into the Undergraduate Curriculum, Mary Ann Robbert, Bentley College...p. 269

3. Process Education: The Third Leg of Software Education, Iraj Hirmanpour, Embry-Riddle Aeronautical University...p. 274

PANEL SESSION 17: 10:00 a.m. - 11:15 a.m.
TOPIC: Organizational End-User Information Systems - The Office Systems Research Association Model Curriculum for Undergraduate Education, Bridget N. O'Connor and Michael Bronner, New York University, and M. Judith Caouette, Pace University, Roger Deveau, University of Massachusetts, Dartmouth, Robert Fidoten, REF Associates, Steve Hunt, Tennessee State University, Charles Lutz, Utah State University, Charles Ray, Ball State University, Elizabeth Regan, MassMutual Life Insurance Co., and Susan Rehwaldt, Southern Illinois University...p. 280

PAPER SESSION 18: 10:00 a.m. - 11:15 a.m.

1. A Comparative Study of MIS Education in USA and The People's Republic of China, C. Somarajan, Southeast Missouri State University, and Jim-Tao Shen, Hangzhou Institute of Electronics Engineering (China)...p. 281

2. Coming to Terms with the Communications Gap Between Managers and IS Professionals, John M. Anderson, University of North Carolina at Wilmington...p. 288

3. The Rising Value of Certification in Information Technology, Ida W. Mason and Ward D. Testerman, California State Polytechnic University...p. 293

PAPER SESSION 19: 10:00 a.m. - 11:15 a.m.

1. Artificial Intelligence and Factory Level Criteria, Reza Eftekharzadeh, St. John's University...p. 298

PROBLEM-BASED LEARNING

WORKSHOP

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Problem-Based Learning (PBL) is an educational methodology for designing and putting into practice curricula that use problems as a context for students to acquire knowledge about science.

PBL was originally developed by the Health department of McMaster University in Canada, but adopted now by several universities. It is seen as a way to address many problems in traditional higher education for the professions. The University of Limburg at Maastricht, Netherlands, after the introduction of PBL for the Health Sciences in 1974 developed its variant in Economics and Business education since 1980.

The workshop will be divided into three equal periods of 45 minutes each:

- In **period 1** a presentation will be given on the seven elements of PBL including the rationale behind it. It will be illustrated by an example of a PBL-task.
- In **period 2** about half of the participants will act as a group of students actually performing a given PBL-task. One of the presenters will act as a tutor of this demonstration group. The rest of the participants will form a circle around the demo group in order to observe what happens. After approximately 30 minutes both the observers and the 'students' will answer a few questions in preparation of the discussion in period 3.
- In **period 3** the experiences of the demo group will be shared and discussed. Questions will be answered and reponses examined.

Company-Wide Quality and Customer Satisfaction Through Quality Information Technology Investment

Workshop

Thomas L. Honeycutt — Rebecca J. Soper

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Traci S. Chamberlain
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Information Technology (IT) no longer has the luxury of existing in a trial and error environment. There is sufficient evidence from both common workplace practices and research to indicate that IT must take the "giant leap" from being a rookie on the playing field to a mature strategic player that enhances the organization's distinct market position.

When carefully analyzed, preliminary results from several workplace practices studies suggest that IT must adopt a more comprehensive form of Total Quality Management that integrates both Business Process Re-Engineering(Hoshin Process) and Continuous Refinement (Kaizen Process) Planning.

McFarlan in March 1995 charged that the greatest obstacle facing the CIOs of the next decade will be to show a Return On Investment in Information Technology (ROIT). To be able to successfully accomplish this task the CIO must tackle the real problems of Change Management and Partnerships with the Business Units.

The Consortium for Information Technology Management Research (CITMR) at North Carolina State University has for the past three years been developing an interactive model of Quality IT Investment. The Information Technology Management Model (ITMM) is a comprehensive management philosophy that has shifted the focus of the IT management paradigm to a mature strategic planning process that requires the integration of both Hoshin and Kaizen planning with shared accountability between empowered boundary-spanning partners.

At the conclusion of the workshop, both Educators and Practitioners will walk away with an innovative philosophy which will enable the current and future IT leaders to face and successfully manage the problems defined by McFarlan while showing ROIT.

Computer Architecture and System Software: Teaching Technical Concepts Successfully to IS Students

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Workshop

The explosion of computer technology has radically altered the duties and responsibilities of the IS professional. The primary professional focus on organizational systems analysis and design has been augmented to include client-server computing, end user support, open system specification and selection, and network design and management, among many tasks. The effective performance of many modern IS tasks requires a basic understanding of the technology underlying information systems. Understanding the technology also provides an essential basis for further learning and personal development as the technology continues to change and evolve. Several published business studies support the view that employers consider this an important area of study for IS professionals. The IS'95 Model Curriculum considers the technology course as a central course within the curriculum.

Despite the importance of this material to IS professionals, there are a number of understandable reasons that many faculty find it difficult to teach the basic technology course. This workshop will provide a forum for the open discussion of issues surrounding the teaching of technology to IS majors. The workshop presenters will discuss methods that they have successfully employed in teaching this material and will offer strategies for delivering a technology course. They will invite open discussion on alternative approaches. If the participants so desire, the workshop may also include discussion of appropriate technology topics, both basic topics and those of current importance.

The agenda for this workshop includes the following discussion areas:

1. A brief description of the contents and rationale for IS '95 Model Curriculum course IS-4.

2. Why is a technical concepts course important to the IS curriculum?

3. The difficulties in teaching basic technology to IS majors

4. Teaching strategies: different course approaches and emphases for different audiences, student motivation, tradeoffs and balances between theoretical and hands-on approaches

5. Course topics and syllabi: sample syllabi, technical content, current topics, methods, and issues

6. Teaching materials and resources: textbooks, simulation software, lab exercises, projects and papers

7. Other related topics of interest and concern to the participants

MULTIMEDIA APPLICATION DEVELOPMENT
LESSONS LEARNED
FROM A FIRST TIME DEVELOPER

WORKSHOP

DAN CARROLL, ASSISTANT PROFESSOR
MIAMI UNIVERSITY, OHIO
SCHOOL OF BUSINESS ADMINISTRATION
DEPARTMENT OF BUSINESS TECHNOLOGY

The purpose of this workshop is to share my experiences with respect to the development of a multimedia application using Authorware. As the title indicates, I will discuss and demonstrate the application development process that I went through from the idea stage to the pressing of the Compact Disc.

The computer industry has unleashed a media blitz of epic proportions in promoting multimedia technology. The magazines and related advertisements give the impression that developing multimedia projects is as simple as buying the equipment, plugging it in, pressing a few buttons and watching the monitor. My experiences, while positive and negative, were not quite as advertised.

In addition to presenting the application development process, topics such as, determining if an idea is suitable for multimedia, a specific listing of lessons learned, and a discussion of the future of the technology from a developer perspective will be covered.

The application was developed using Authorware and includes video segments of the author introducing and discussing the material, voice over audio recordings and interactive questions (multiple-choice, true/false, fill-in, icon movement). The final output consists of a Compact Disc for use in a Macintosh environment.

A PowerMac computer with a CD player will be used to demonstrate the completed application. Authorware and the completed programming code will also be available so that I can demonstrate the application as it was being developed.

W O R K S H O P

INTRODUCTION TO CLIENT-SERVER APPLICATIONS USING DELPHI

Carlin Smith, Jr.
Purdue University

ABSTRACT NOT AVAILABLE AT PRESS TIME

AN INTRODUCTION TO BRIEFCASE III FOR WINDOWS

WORKSHOP

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The purpose of BriefCASE III is to provide students of systems analysis and design courses with a simple, convenient, and low-cost Information Systems (IS) development tool suitable for typical educational environments and resources. Briefcase III contains the essential CASE capabilities of data modeling, process modeling, repository, and prototyping. It has a flexible design allowing for the implementation of various IS development methodologies and for creative use by students.

BriefCASE III has been designed and developed by a university faculty member (Galen Crow) engaged in the delivery of typical systems analysis and design courses. Further, BriefCASE III has been tested and critiqued by various college faculty and in several systems courses nationally. Additionally, the developer and publisher (Boyd & Fraser) of BriefCASE III are committed to upgrading this product in a timely manner based upon customer input.

The workshop will include an overview of the design the Briefcase software and will explore its major features. Participants will be shown how to create process models, data models, detailed specifications, and prototypes. Included also will be a discussion of how students would create projects using BriefCASE III.

**"VIDEO IN THE CLASSROOM:
PRACTICAL APPROACHES TO INTEGRATION"**

WORKSHOP

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Innovations in instructional technologies can have a dramatic impact on the classroom learning experience. Using a variety of media, educators can now shape class time into engaging and informative sessions where students hear, see, touch and discuss what they are learning. Video-based materials have been a growing part of such multimedia presentations for some time, and while not as high-tech as other instructional technologies, they offer educators tremendous flexibility in their usage and applicability.

This workshop will cover the reasons for using video materials in the classroom and the categories of videos available for use, such as instructional replacement, application and case-based, and promotional. Samples of representative videos will be shown where appropriate. The workshop will also present suggestions for evaluating video material quality, offer ideas on where to locate video materials for use in the classroom and provide a forum for discussion of video material use among those in attendance.

WORKSHOP

HYPERTEXT MARKUP LANGUAGE FOR EDUCATORS

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ABSTRACT NOT AVAILABLE AT PRESS TIME

FACULTY MULTIMEDIA DEVELOPMENT IN A WINDOWS ENVIRONMENT: A DISCUSSION OF ISSUES IN DEVELOPMENT AND DELIVERY

WORKSHOP

William H. Moates
Indiana State University

This workshop will be an open discussion of hardware and software issues involved in the development of multimedia tools for the classroom and for student use in an academic environment. As time permits, some of the issues to be discussed are the following:

Deciding the level of sophistication desired. Multimedia use can range from a simple slide or CD-ROM presentation to the integration of voice, music, and video materials in an interactive environment. The choice of media used affects the level of retention. Also, as in most development environments, the level of sophisication to be used affects ensuing decisions as to hardware and software choices. For example, if all is needed is supplementary lecture slides, simple presentation packages may be sufficient.

Selection of hardware. More powerful hardware capabilities are required for multimedia development than for traditional software development. Faster processor speeds, more RAM, larger secondary storage capacities, high resolution graphics capability, a sound card, and a CD-ROM drive are necessary to satisfactorily equip a multimedia development environment. In addition, depending on the desired sophisication of the product, a video capture board, video cameras, video disk players, and video playback and editing equipment may be required. In order to record CD-ROM disks, a CD-ROM recorder (or "burner") is needed. The more complex the end product, the greater the capabilities of the hardware must be.

Selecting development software. The software tools available for development range from presentation tools, e.g., Microsoft PowerPoint, to authoring tools, e.g., Macromedia Director. Also, other tools can be used to assist in specialized aspects of development, such as creating special effects, generating 2- and 3-D animation, and editing audio and video materials.

Planning and organizing the development process. In multimedia development, traditional analysis and design, coding, and testing procedures should be followed. In addition, the creation of storyboards, timelines, and other tools traditionally used in audio and video production must be integrated into the development process. Thus, a level of expertise in using tools and techniques which are not traditionally taught or used in software develoment environments must be developed or at least accessible. Skills in video and still image photography are one example. Some knowledge of film editing is also useful. Also, The design of the user interface is crucial to success in multimedia creation. Graphical design and layout skills are useful here.

Delivering the output to the intended audience. The equipment used in the classroom usually consists of an LCD panel with a computer interface, a high-lumen overhead projector, speakers, and a computer which has sufficient equipment, such as a CD-ROM drive or a large hard drive, to permit effective delivery of the product. RGB projectors with digital interface capabilities are also a possibility, but are more expensive. If the materials are to be distributed to students over a network or via CD-ROM, the user computers must be equipped with sound cards and CD-ROM drives, as well as high-resolution monitors and graphics accelerator cards. In a lab situation, earphones will be a necessity.

WORKSHOP

DEVELOPING SIMULATED APPRENTICESHIP UNITS FOR INFORMATION SYSTEMS COURSES

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The development of analyst skills requires a combination of academic education and on-the-job apprenticeship. However, the advent of downsizing and decentralizing decreases the opportunity for on-the-job mentoring. Simulated Apprenticeship attempts to compensate by replicating real life work activities in the classroom.

The first segment of this workshop examines the trade-off between apprenticeship training and academic pedagogy. A brief survey of cognitive apprenticeship leads into the basic concepts of Simulated Apprenticeship, an adaptation of apprenticeship methods for the academic classroom. Under Simulated Apprenticeship the students are told to forget that they are *students* in a *college* taking a *course* taught by a *professor*. Rather, they are *analysts-in-training*, hired by a *consulting firm*, and they are enrolled in a *workshop* run by the *Chief Analyst*. Instead of a *homework assignment* they are given a *consulting engagement* for a client. Instead of *written exams*, they must personally give the Chief a *briefing* in preparation for a client walkthrough.

Attendees will receive a sample syllabus and materials for a Systems Analysis course. [A.B. Kahn (1995) Simulated Apprenticeship in System Analysis Courses, Journal of Computer Information Systems, vol 35, no 2, 5-15.]

From Systems Analysis, the discussion will move to two generic assignments which are adaptable to advanced courses in almost any technical discipline. This in turn leads discussion into the broad applicability of Simulated Apprenticeship to other courses including a junior level writing course in the English department.

Finally this session will challenge participants to adapt Simulated Apprenticeship to their own teaching environment. Participants will devlop a plan for a consulting engagement for use by their own ~~students~~ apprentices.

Introduction to Windows 95/Office 95

Robert T. Grauer, University of Miami

Windows 95 made its long-awaited debut on August 24th accompanied by new versions of Word, Excel, and PowerPoint (Access is expected within 60 days). Windows 95 is a radical departure from Windows 3.1 whereas Office 95 is more evolutionary in nature. With an installed user base of over 100 million copies, the impact of Windows 95 will be significantly greater than when Windows 3.0 made its debut in 1990. This workshop examines both Windows 95 and Office 95 with respect to new features and differences from their predecessors.

Windows 95 is the result of extensive usability testing that included nearly 50,000 beta testers world wide. The overriding goal for the new operating system was ease of use, as Microsoft discovered that many aspects of Windows 3.1 were "non-discoverable". It is reasonable, therefore, to discuss the operating system from the viewpoint of the first time user as well as the experienced Windows user. The former can expect to be up and running more quickly than in the past. The experienced user, however, has an initial "unlearning curve", during which time he or she realizes that many treasured shortcuts no longer apply. The workshop will focus on the new interface and examine some of the core technology improvements.

Office 95 is a much easier adjustment for experienced users. Virtually all commands are in the same menus, and thus one can continue to use the same techniques as in the past. In addition, several new features have been added and will be reviewed during the workshop. As of this writing the programs in Standard Office (Word 7.0, Excel 7.0, and PowerPoint 7.0) have been released and hence can be covered in detail. Coverage of Access 7.0, however, will depend on its availability at the time of the conference.

Attendees will receive a ten to twenty page handout containing highlights from the presentation.

A CULTURAL FOUNDATION FOR MAXIMIZING THE PAYOFF FROM INFORMATION TECHNOLOGY

A Workshop at DPMA-ISECON'95, Charlotte, NC, November 3-5, 1995

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THE ISSUES

The breathtaking pace of technological advances may have conditioned most of us, technophiles and technophobes alike, to believe that our work and life will inevitably be driven by IT. Ironically, this can become the major obstacle in realizing its true benefits. Ultimately, hardware does not add value, nor does software. *People do.* Unfortunately, most people do not have the proper perspective that will allow them and the organization in which they work to maximize the payoff from technology. To date, the role of providing such an orientation has fallen through the cracks among IT professionals, educators, as well as human resource managers. This workshop presents both the big picture for such issues and specific agendas for all three groups to facilitate their respective missions.

CRITICAL QUESTIONS ANSWERED

- What are the two most significant changes brought about by IT?
- How are organizations adapting? How does this affect the future of jobs and careers?
- Why do so many TQM and BPR initiatives fail to achieve their intended improvement?
- Is there a winning mindset for true benefits from IT? What kind of culture does it imply?
- How can educators, IT professionals, and human resource managers nurture this culture?

WHO SHOULD ATTEND

- *Academics*: Efforts to develop MIS as an academic discipline have led to narrowly focused specializations. This workshop is a reality check that may help revitalize courses and curricula.

- *IT Professionals*: Emphasis on technology has overlooked the human side of the equation. Here is a key to better communication with end-users, who are after all, the customers.

- *Executives and Managers*: Top-down managerial mandates—BPR, TQM, Organizational Learning, Time-Based Competition, etc.—cannot realize their full potential without a supportive cultural foundation among the employees. See what can instill motivation and self-confidence.

PRESENTER

Dr. James K. Ho is a professor of information and decision sciences at the University of Illinois at Chicago, where he also serves as director of applied research and consulting services for the College of Business Administration. He has extensive experience working with international organizations, major corporations, as well as small businesses on the application of IT in the workplace. He is author of a new book *Prosperity in the Information Age: Creating value with technology—from mailrooms to boardrooms* (Wilmette, IL: Infotomics, 1994) on which this workshop is based.

W O R K S H O P

CREATING WORLD-WIDE WEB PAGES USING MS WORD

Victor Barlow
Purdue University

ABSTRACT NOT AVAILABLE AT PRESS TIME

WORKSHOP

Introduction to UNIX for IS Educators

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ABSTRACT

This workshop provides an opportunity for Information Systems professionals and educators to get an understanding of the UNIX operating system and why it has become so popular. The workshop emphasizes a concepts approach which will permit participants to begin using UNIX after taking this seminar.

Workshop Topics:

I. Introduction: History, Philosophy, Versions

II. Using UNIX: User interface, files, processes

III. The UNIX Process Model

IV. The Information Systems Development Environment

V. Conclusion: UNIX system comparison, Relationship to OS/2, DOS; Summary

USING HUMOR IN THE CIS CURRICULUM

Workshop

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The idea of combining humor and computers may seem unusual to some people, but I have used humor to teach computer courses for over fourteen years. A variety of techniques can be employed to express humor. These methods include story telling, comics, jokes about yourself, making light of something that you have done, or published materials. Sources of humorous material abound.

Some students believe that nothing about a computer is funny. Some of the things that occur while I am using a computer are so humorous that I could cry. Did I really delete the program that I spent the last three hours entering and testing? It must be an impostor that leaves the diskette with the run-time version of the software that I need for the client's presentation at the office. How can someone who uses a computer every day have so much trouble double-clicking? If only I made backups, as I preach to my students, so that when the message "disk controller error" appears, I do not panic and wonder when was the last time I backed up the hard disk. Despite all the difficulty and frustration that I often experience due to my constant dependence on these darn machines, I still find a great deal to laugh about.

There are some interesting questions that can be asked about using humor in the instruction of computer courses. Does the use of humor improve the learning environment for the students? Do students learn more in classrooms where humor is used during instruction? What impact does the use of humor have on international students? Can humor be used to gain the student's attention or improve retention of material? When is humor appropriate in the classroom? Are students more comfortable in classes where the instructor uses humor?

This workshop will present ways to incorporate humor into the classroom when teaching technical topics such as computing. The workshop will review some important work that has been done on the use of humor in the classroom. Some techniques for using humor during instruction will be explained. The workshop will explore the appropriateness of humor in certain situations. The presenter will share some of the humorous material that has been compiled over the last fourteen years. Finally, the presenter will share the results of an attitudinal survey. The survey contained twenty Likert-scale statements about the use of humor in the classroom. The survey was completed by students in Computer Information Systems classes.

INVITED KEYNOTE ADDRESS
STRANGE NEW WORLD:
THE SKILLS CRISIS IN CORPORATE INFORMATION SYSTEMS

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ABSTRACT

The corporate information systems world is undergoing massive upheaval which is fundamentally changing our assumptions about skills building. These changes are happening very quickly, causing dislocation in the workforce, pain and suffering for people whose skills have suddenly become outmoded and changing long-standing corporate practices in education and recruiting. Gove are the days when a background in COBOL and structured programming was enough to ensure a good job and secure future. Technology changes, combined with business restructuring, has shifted the value equation to favor expertise in technologies that didn't even exist a few years ago. Corporate America is now wrestling with the dilemma of having to pay six-figure salaries to 28-year-old SAP specialists while systems analysts with 20 years' experience are making half that amount. The skills imbalance caused by the rapid emergence of so many new technologies that have quickly become business critical is throwing IS organizations into turmoil and making skills acquisition the number one issue among corporate chief information officers.

Underlying this phenomenon are some basic changes in technology and business. The most basic is the continuation of Moore's Law, which is roughly recreating all the hardware price/performance improvements of the last 50 years every 18 months. The marginalization of hardware as a significant systems issue has been a profound shift in the industry in just the last five years. In addition, the emergence of high-speed networking and the Internet as corporate facts of life have spurred user organizations to put much more emphasis on issues of interoperability and communications. Client/server has become the dominant architecture for new systems development and electronic linkages between business and their suppliers and customers are an exciting enw area for business growth.

On the business side, massive corporate restructuring over the last five years has created the need for new models for corporate information systems. The big, vertically inteegrated corporate IS department is out. It's being replaced by a leaner, decentralized model that brings IS people more closely together with their end-user customers. The trouble is, no one has yet figured out how to organize these new department,s much less how to pay for them. The computer user base in corporate America has increased by roughly a factor of 20 is the last 10 years, yet our techniques for supporting these people are siill based, for he most part, on procedures developed during the era of 3270 terminals. Change is occurring, but it is a slow and painful process for many people.

These factors will have major significance for computer educators because the needs of corporate employers are changing so fast and so radically. I won't try to tell educators what they need to do, but it is clear that the world into which their students pass upon graduation will be very different from the world of just five years ago.

An Undergraduate Degree in Multimedia Design and Development: Collaboration Between the Departments of Computer Science and Information Systems and Art

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Abstract

This paper addresses the creation of a new undergraduate degree program in Multimedia Design and Development that is the joint effort of two departments: Computer Science and Information Systems (CSIS) and Art. First, the evolving state of Computer Science and Information Systems curricula are examined to provide relevant academic context for this new degree. Second, the emerging field of multimedia is examined to provide relevant real-world context for graduates with this degree. Third, the newly developed multimedia design and development degree is described with emphasis on the joint, collaborative nature of this program.

Computer Science and Information Systems Curricula

Computer Science (CS) and Information Systems (IS) curricula guidelines are increasingly putting a strong emphasis on the integration of theory and practice. For example, both AACSB (1991) and DPMA (1991) guidelines have stressed the need for integration of important concepts across the curriculum in terms of learning the theory and practice of information systems. In response, Becker et al. (1991; 1992; 1994) examined the chasm between theory and practice that often exists in IS curricula and developed an instructional model based on the DPMA guidelines that initiated a study of a three-phase approach for integrating course content and allowing students to apply this knowledge in information systems development.

To address this need as well as needs in IS curricula, a joint task force representing the Association of Information Systems (AIS), the Association of Computing Machinery (ACM) and the Data Processing Management Association (DPMA) as well as other relevant associations is currently working on model curriculum and guidelines for undergraduate degree programs in information systems.

The growing dissatisfaction with existing curricula and the desire to evolve these curricula into more practical, application-oriented programs also extends to the discipline of Computer Science. Computer Science has been the subject of much discussion concerning relevance of the degree programs and application of the knowledge and skills from those programs to real-life situations (Denning, 1989, 1992, 1993; Tucker & Barnes, 1991; Stevenson, 1994).

Ives (1993) in an editorial in *MIS Quarterly* advocates "transforming the learning industry" by making university curricula more relevant to the marketplace and by incorporating multimedia-based learning and teaching into the university. Both of these themes contributed to the rationale behind the new undergraduate degree in multimedia design and development addressed in this article.

Multimedia Defined

Multimedia, according to the generally accepted definition (GISTICS, 1993), is a technology, product or service that integrates into one box (TV, microcomputer, stereo component, network access point, or other hardware) more than one medium, whether audio, text, still images, animation, or full-motion film/video, and that allows the user interactivity through some means of guidance and control.

But multimedia is more than better presentations, more than fascinating entertainment, and more than smart picture databases. Multimedia invites involvement and interaction from the user. High-quality multimedia does this without a fixed user interface or rigid procedural hierarchy by making every symbol on the screen an interactive, multilevel discussion about what it represents, how it relates to other items, and how to find out more about it. A robust multimedia application is intuitive, self-paced, and allows the user to selectively explore it various dimensions. What users desire is participation, control and responsiveness.

A unique and powerful feature of multimedia computing is the ability to model and simulate experiences. Users flow back and forth between the real and make-believe worlds. Multimedia can be used to create multiple, simultaneous feedback systems which facilitate deeper learning processes.

Multimedia Demand

A report issued by GISTICS (1993), a market survey firm, reports that by 1997, 90% of all personal computers sold in the U.S. will be able to perform multimedia functions and have the ability to play full-motion video of near-broadcast television quality and high-fidelity audio. Industry sales of multimedia software, services and related peripherals will reach $3.6 billion by 1996, compared to $350 million in 1993.

Hardware sales of multimedia products, including computers, set-top boxes and personal digital assistants, will leap to $3.0 billion in 1996, compared with $75 million in 1991. IBM, Microsoft and Apple are informing their key partners that multimedia will be the strategic set of capabilities that differentiates profitable product lines from the cadre of low profit margin "clones" that mimic lowest common denominator personal computer capabilities.

Financial pressures, the need to respond quickly to consumer demands and the enormous array of multimedia applications will reinforce a trend towards smaller, more flexible "creator" work groups and industry alliances as the way to speed products to market. Joint ventures between major hardware vendors, such as IBM and Apple, will continue to move the industry forward to generating standards and technologies. Value-added partnering and collaboration will redefine the notion of corporate competitiveness in the new media industry.

Demand will come from three market segments: business, education, and the home. Business alone will account for a $2.9 billion market (hardware, software, and services) by 1996, with applications such as video-conferencing, interactive marketing materials, and job performance support addressing needs in worker training, job performance support and workgroup communications.

Multimedia in Business

There is a fundamental shift occurring in business and business education. There is a wealth of literature (Drucker, 1990; Katzenbach & Smith, 1993) showing that organizational hierarchies are breaking down, and management structures are becoming more lateral. The worker whom is told by a manager what to do, is giving way to the "knowledge worker" who is supported by professional skill, self-discipline and sophisticated computer-based support tools where the management and methods are built in. The knowledge worker is self directed and capable of managing himself. Multimedia will be a primary resource to train and support the knowledge worker. As business develops this new working paradigm, multimedia will flourish.

As industries are restructuring, they are making workflow changes to enhance efficiency. Their demand for delivery of improved levels of communication and information at lower net costs will continue to increase as they emphasize greater market and operational efficiencies. A key element in this restructuring is the drive to create on-going cost reductions. As businesses seek better economies of scope they will fine-tune organizational and communication resources by utilizing multimedia to help them move away from "broad-casting" and towards one-to-one "point-casting," targeting specific information to those who need it.

At the same time, businesses are engaged in an on-going process of quality improvement, both in the business process itself and in the customer's experience. Internally, this requires improved delivery of training and employee support. Externally, a business must continually re-educate and support the customer throughout a solution life cycle (the period of time during which a product is productively used). A critical success factor in business will be how to deliver information to an internal or external audience without breaking the budget or aggravating the receiver. Multimedia will play a major role in providing an enticing way to deliver large amounts of information to a finely targeted audience in a cost-effective manner.

Multimedia in Education

It is widely accepted that models can effectively represent events and processes that may not normally be understood or even seen by human observation (Dede, 1987; Marchionini, 1988). For example, consider the micro world of bioengineering or the macro worlds of astronomy or global environmental awareness. Computer make models easier to use. Many computer models have been designed as tools for visualizing, understanding and predicting the future. Examples include flight simulators, city planning models and business simulations. The most popular and broadly commercialized simulated-reality models are video games and entertainment kiosks.

Multimedia provides the means to simplify and expand the use of models with simulation and interactivity. As models are combined with simulation, they become more powerful learning environments. Simulation enables us to examine the impact of various possibilities. Pilots, medical professionals, and engineers explain that simulations provide the opportunity to make a lot of mistakes and learn from each one at a fraction of the real world cost. Simulation and modeling are a way of learning complex skills in a safe, entertaining, cost effective way.

The education sector wants more effective teaching techniques and many observers believe multimedia is the solution. Teachers want to off-load the boring-to-teach subjects to learning media centers, freeing them up to deliver more creative and meaningful curricula. School administrators want to reduce the cost per student by realizing the productivity and headcount savings of automated instructional delivery. Policy makers at the local, state and federal levels want greater skills development in math, science, and literacy Teacher unions want greater teacher control of classrooms and instructional delivery. These are the needs and opportunities that multimedia is uniquely suited to fulfill.

Peter Blakeney, manager of U.S. Operations for Multimedia at IBM emphasizes that IBM is in the educational multimedia market for the long haul. "Education is a quarter of a trillion dollar industry," says Blakeney. "We can provide greater efficiency and performance capabilities through multimedia-enabled information systems technologies." The field of corporate training and education combines elements of the business and education sectors. Blakeney of IBM points out that training is a $50 billion business in the private sector, and another $50 billion in the public sector.

Textbook publishers such as Simon & Schuster and Macmillan, as well as entertainment companies such as Disney and Paramount, are preparing for the electronic markets. In the next decade, multimedia reference and curricula on optical disk will go into the libraries and media centers of the K-12 segment. Electronic reference books, especially multivolume encyclopedias and annuals, cost more initially but require less shelf space and are less expensive to update or reprint. Such economies, coupled with the enrichment of information access and learning experience, will lead schools to adopt electronic references over printed versions. Also, interactive science curricula will fill school media labs.

Undergraduate Multimedia Design and Development Degree Program

In recognition of the evolving nature of CS and IS curricula and the emerging field of multimedia design discussed above, the Departments of Art and Computer Science and Information Systems at The American University in Washington, D.C. have created a new undergraduate major designed to provide the necessary training for this new discipline.

The B.S. degree in Multimedia Design and Development blends courses, practices, technologies, and skills primarily from graphic design and information systems. The program also includes components that relate to the production of video and audio for integration into multimedia presentations.

The goal of the B.S. degree in multimedia design is to produce graduates who enter the work force as professionals who manage and direct the design and development of multimedia presentations integrating text, graphics, animation, audio, and video. Reflecting the different skills that are required to accomplish this integration, the degree involves a collaboration between two departments and will offer a blend of Arts and Sciences hitherto unknown at American Univeristy.

Rationale for a Joint Degree

The motivations for the creation of this proposed program come from several areas. Information systems professionals are increasingly more involved in the human interface of technology and graphic designers have migrated from the drawing board to an electronic platform. Examples of how computer knowledge and graphic design skills are blending can be seen in three emerging technologies. One is the inclusion in the publishing industry of multimedia "texts." the second is the delivery of interactive multimedia television to every household in the U.S. within the next five years. The third is the emergence of multimedia as the basis for educational technology.

Multimedia and Publishing

At a recent conference (Invitational Conference on Dissemination, May 31 to June 3, 1994, sponsored by the National Science Foundation (NSF)), over forty major textbook publishers met with over 250 undergraduate educators (recipients of major NSF educational grants) to explore changing paradigms for knowledge dissemination. Publishers and authors alike agreed that the dissemination of knowledge through the printed textbook is rapidly being supplanted by learners' interacting with "electronic texts." The dilemma expressed by publishers (and authors) is how they will build the authoring infrastructures that will permit the production of interactive, multimedia texts to meet the burgeoning demand for both formal and informal education. At the same time, authors are faced with a radical shift in thinking about how to disseminate their knowledge -- static words on static pages do not lend themselves to electronic-based, interactive, multimedia learning.

The consensus of the publishers (and those authors who already had experience in trying to produce texts in multimedia) is that a new kind of publishing force is evolving, one where experts in graphical, video, and audio presentation of information work in teams with content experts to develop interactive texts. Publishers vocalized their concern that few college curricula prepared graduates to work in this evolving field and that publishing organizations are not staffed with appropriately trained professionals to serve the new publishing paradigms.

The curriculum encompassed by this degree is designed to produce graduates that not only meet the needs of the textbook publishing industry but also the needs of any publishing enterprise from advertising to entertainment. Computer-based publishing is transforming the presentation of information so that newspapers, advertising brochures, magazines, encyclopedias, training materials, games, and other printed materials will be delivered in electronic (and largely interactive) formats. The preparers of these electronic-based media need to be especially trained (in graphics, computing, and new design metaphors) to produce such materials on electronic platforms.

Interactive Multimedia

It is estimated that by the year 2000, the national fiber-optic telecommunications backbone that brings broadband interactivity into every household in the U.S. will be completely installed. As of May 1994, one local communications provider, Bell Atlantic, had already installed Interactive Multimedia Television (IMT) into approximately three hundred households in Northern Virginia to beta-test their IMT delivery system. It is worth describing the services anticipated and being tested by the communications carriers. The scope and format of these services are such that graduates of the new B.S. program will be in great demand for IMT efforts alone.

Communications carriers envision (and are developing) IMT as delivering retail, educational, governmental, and other services directly to the household through interactive user selections of services. The delivery format is interactive-multimedia based with high reliance on graphics, video, text, and sound. The metaphor used in the Northern Virginia beta-testing is the "Shopping Mall." Through their television sets (and later through PCs), users find providers of services and products through a multimedia front-end. They then interact with providers through customized multimedia interfaces to select services and/or products remotely from the actual location of the provider. For example, using the mall metaphor, if a subscriber wishes to locate a recorded performance of Beethoven's Ninth Symphony by the Berlin Philharmonic, the subscriber may locate (by navigating through a graphical multimedia front-end) a music provider (i.e., record shop) in the information "mall" and search the provider's holdings (using a customized search front-end) for the particular recording desired. Likewise, customized multimedia front-ends are being developed that permit the subscriber to browse a provider's holdings (again using multimedia) with no particular product or service in mind.

IMT providers do not anticipate that they will amass the work force capable of building the customized multimedia front-ends that retailers and other providers require. They envision that new industries will rapidly proliferate which will provide the multimedia productions for the "residents of the malls." The new B.S. degree will prepare graduates to function as practitioners in these new industries, and, in fact to be entrepreneurs themselves in their own start-up companies.

Multimedia in Educational Technology

The "talking-head" aspect of the classroom knowledge-transfer experience is an aging paradigm, one that is being replaced by experiential classroom learning with learners taking a more active role in their education. Multimedia-based lecture materials are rapidly augmenting and replacing the blackboard.chalk model. Nationwide, both at K-12 and college levels, classrooms are being renovated to accommodate multimedia projection systems. Learning environments (schools and business) are building educational technology delivery infrastructures that include not only equipment and space for multimedia-based education but also the teams of professionals who support the lecturer who is developing multimedia for a "lecture" environment.

It is anticipated that the new multimedia design and development degree will prepare graduates to work in Educational Technology centers that produce materials in this rapidly growing field.

Multimedia and Graphic Design

The world of the graphic designer has been revolutionized by the introduction of computing technologies. paper-based design executions have been largely replaced by computer-based conventions (though there will continue to be a demand for print graphics). In operating in an electronic environment, it is not enough for practitioners to understand traditional graphic design principles, they must also be able to integrate these principles with electronic platforms, some of which automate many of the non-creative aspects of producing a design. Graphic designers have to be cognizant of computing systems and software in order to compete effectively.

The existing Design Program at The American University has already made dramatic progress in combining technology with a traditional design education. The advent of multimedia design has added a new, more complex dimension to this blend. For the field of multimedia this relationship must be pushed further to a point where the line between designer and computer specialist is less defined.

The requirements for a sound multimedia education involve the efforts of both the graphic design and computing programs. It is truly a combination of two fields, not a supplement to either program. This degree is intended to produce graduates who can function as graphic designers in a computing-based work environment, and, in particular, to prepare them to expand their graphic design capability to include the production of multimedia.

Academic Departments

Art Department -- The mission of the Art Department is to provide students with a theoretical understanding and practical fluency in visual language. The Design Program emphasizes the need to communicate clearly to target audiences. In addition to visual skills, this requires the ability to research and work with clients, service bureaus, and production houses in a collaborative effort, a union of creativity and organizational abilities.

The inclusion of the computer as a tool in this process is just the most recent development in a long history that uses technology to facilitate graphic communication. In multimedia, the computer is now not merely a tool for preparing art for the printer but has become an information medium in itself. The flexibility of information access is unlike anything that has been previously seen. Alternative ways of viewing concepts are now built into the process. This avenue of visual communication builds on the design program's mission and goals and will require designers who can combine analytical ability, creativity, and computing skills.

Computer Science and Information Systems Department -- The Computer Science and Information Systems (CSIS) department has a well defined mission that is captured in both the department's mission statement and its program review documents. Briefly, the department concentrates its research and curricula developments in three areas: Intelligent Information Systems, technology Transfer, and Information Systems Engineering and Evaluation. This degree program bridges all three areas but is concentrated in the second -- technology Transfer. one aspect of technology transfer defined in the CSIS mission is research and development into multimedia and the delivery of educational materials using multimedia (i.e. educational technologies). The B.S. in Multimedia Design and Development fits well into the curricular aspects of this area of the CSIS mission. In addition, there are aspects of the new degree that fit into the other two mission areas. The construction of quality software (whether it supports multimedia or any other applications of computing) is an important part of the new degree and resides in the third CSIS mission area -- Information Systems Engineering and Evaluation. The first mission area -- Intelligent Information Systems -- is of vital interest to researchers in multimedia since multimedia provides a fertile testbed for experimentation with intelligent front-ends to information systems and vice versa (i.e., multimedia front ends to intelligent systems).

In keeping with the second CSIS mission area, in 1993-1994 the department developed a multimedia development laboratory (Gleason, et al., 1993), presented three major showcases about multimedia, and offered courses in the development of multimedia for education to faculty in the College of Arts and Sciences based upon previous research and course development of IS faculty (McGuire, 1991).

Integration with Existing Programs

The Art Department currently offers a B.A. degree in Graphic Design concentrated on print graphics. This program will not be eliminated in that the demand for print graphic practitioners will continue and a cohort of students will elect to focus on print graphics.

The B.S. in Multimedia Design and Development enhances the offerings in Graphics Design as it is attracting new students (most of whom will utilize existing Graphic Design courses) who focus their studies in electronic media as opposed to print media.

The CSIS Department currently offers B.S. degrees in both Computer Science and Information Systems. The B.S. in Multimedia Design and Development uses incorporates courses from both these disciplines (three from each discipline plus one new integrated Multimedia Practicum course in multimedia development).

Practical Experiences

Student participation in a cooperative education course (where students work in the field) is a requirement of this program. Evidence of the success of the integration of a cooperative education experience with on-campus learning is substantial. This program, in particular, lends itself to a cooperative education experience because of the large number of high-tech organizations in the area (third in national ranking to Silicone Valley in California and Boston) and the large number of multimedia development firms in the area.

Although not a requirement for this program, an additional opportunity for students is the wide availability of summer and part-time internships. As with cooperative education opportunities, internship opportunities are readily available for majors who stay in the Washington, D.C. area over the summer or work part-time during the academic year.

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An Innovative IS Curriculum Design: a Mixed-Mode, Phased Structure

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ABSTRACT

The IS curriculum has the distinctive features of a mixed mode of full-time/part-time attendance. It has the following highlights: a high degree of influence by potential employers is incorporated in the design; the development process adopts a structured systems analysis and design approach; and success is dependent on the affluent economy in Hong Kong at the time. The paper provides an overview of the development process that leads to the resultant curriculum. It also reports a post implementation review including feedback from graduates of the programme.

1 INTRODUCTION

The IS curriculum refers to the BSc in Computing Studies with emphasis on Information Systems [HKBC 1991 and Lee 1993] which is offered by the Hong Kong Baptist University[1]. The design was motivated by the shortage of manpower at entry level in the end user sector of the computer industry in Hong Kong [VTC[2] 1989]. The programme was validated in April 1989 by a government-appointed panel of experts and was commended *an innovative structure, without precedent amongst computing courses in the United Kingdom* [CNAA 1989]. A further validation was carried out in March 1991 by the HKCAA (Hong Kong Council for Academic Accreditation). Its first intake, commenced in the autumn of 1989, graduated in the summer of 1994.

The curriculum is innovative because of its mixed mode of full-time and part-time attendance, and its emphasis on end user consideration. Students will have an opportunity to learn while practising in a real world situation. They will also be accepted for employment upon graduation. Another feature of interest is that the development of this curriculum follows the *structured* approach [Yourdon and Constantine 1975, Gane and Sarson 1978, DeMarco 1979].

This paper presents first of all a brief introduction of the IS curriculum. Then it goes on with data collection, analysis of end user opinion, and design of contents and structure. Finally, it concludes with a review of the effectiveness of the design.

2. THE INNOVATIVE CURRICULUM

2.1 Aims and Objectives of the Curriculum

The general aim of the curriculum is to produce graduates who will have at the end a solid foundation in both the theoretical and practical disciplines which are essential for a successful career as information systems specialists. That is, graduates will, in addition to gaining specialist knowledge, not only be able to solve problems on the basis of analytical and systematic thinking but will also be capable of liaising with end users, decision makers at various levels, and technical peers, in the process of developing the information systems.

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1 HKBU (formerly Hong Kong Baptist College) is one of the seven government-funded institutions of higher education in Hong Kong. Permission by the President and Vice Chancellor of HKBU to refer to this curriculum and the information on its development is gratefully acknowledged.

2 VTC (Vocational Training Council) is an agency of the Hong Kong Government responsible for vocational guidance and training. It publishes a report annually on manpower survey of all industrial sectors.

2.2 Requirements of the Curriculum

To meet the aims and objectives, and be relevant in the Hong Kong context, the curriculum must address four key issues. First, in Hong Kong, a significantly high proportion of job openings is for Programmers and employers in general desire formal qualifications in Computing.[3] Second, the output of graduates in the field of Computing from other institutions in Hong Kong has not satisfied the demand. [VTC 1989] Third, the majority of fresh graduates are expected to be employed initially as Programmers.[4] Fourth, this course will need to prepare graduates to proceed to advanced study in Information Systems, if they so desire.

This means that (a) the course needs be able to accelerate the supply of Programmers, (b) a flexible mode of attendance is necessary to cater for the dynamic nature of a Programmer's job, and (c) the proposed curriculum as a whole should be designed at an honours degree level.

3. THE DEVELOPMENT PROCESS

3.1 Feasibility Analysis

To determine the reaction from potential employers about the planned curriculum, an extensive set of interviews is conducted involving four main areas.

First, what are the prospects for those students, who have completed the first two years of full time study, of finding entry level programmer jobs? Second, what is the usefulness of the Phase 1 curriculum (in the first two years) in preparing students for Phase 2 while working as programmers? Third, what may be the impact of the duration, five years in total, on the career development of prospective graduates? Fourth, what are the abilities, skills, knowledge and general qualities that are perceived by potential employers to be most important for a quick "pick-up of the trade" by a novice given the employer's current environment?

[3] Minimum acceptable qualification: Strong preference for degree-level qualifications is indicated. However, 37% and 43% of Systems Analyst and Applications Programmer, respectively, with sub-degree qualifications are appointed. [VTC 1989, sections 2.13 and 2.14, and appendix 10]

[4] Overall recruitment pattern in 1988 by job level: Over 70% of 3588 EDP positions at professional rank filled, are in the areas of systems analysis (15%) and applications programming (56%). [VTC 1989, section 2.11]

3.2 Survey of End Users - Potential Employers

A combination of questionnaire and interview is used to collect data from members of the Hong Kong Computer Society and the EDP Management Club of the Hong Kong Management Association. The interviews are conducted by the academic staff of the Department of Computing Studies.

591 companies were selected from the 1987 *Asian Computer Directory*. All selected companies employed at least two programmers. Targeted interviewees were classified into three categories: manager, systems analyst, and programmer. The questionnaire was refined by brain-storming sessions attended by the course planners and the designer of the questionnaire. Then, it was pilot-tested. Of the 591 companies contacted, 266 (or 45%) agreed to an interview. The 266 companies interviewed employed a total of about 4000 computer professional staff.

The data collected (presented in the 6.1 Appendix 1) indicate an overall support. Moreover, the results reveal (a) a clear consensus on general qualities; (b) a similar consensus, but to a lesser extent, on language and communication abilities; (c) a much less consensus on business or commercial knowledge, and technical abilities; and (d) a common opinion that the following knowledge is unimportant: basic principles of Economics (68.4%), elementary statistics for business (48.9%), management decision support systems (41.7%), AI and expert systems (66.9%), and CAD or CAM (71.1%). The results also allude to a favourable employment prospects for Phase 2 students (that is, they should have little difficulty in locating relevant jobs). The prospective graduates will be treated fairly by employers (that is, the length of study should have no adverse effect on their career). In fact, because they are free to choose employers, they may in the end be more advantageous over their counterparts from the conventional three-year or four-year full-time or sandwich courses. The opinions expressed by the employers in the questionnaire have provided valuable pointers for designing the curriculum, especially for Phase 1 subjects.

3.3 Requirements analysis

A flexible mode of attendance can be arranged on a mixed full-time and part-time basis. Students will follow a full-time study programme for the first two years (Phase 1) and then complete the remainder by part-time study over a period of three (normally) to five years (maximum) (Phase 2).

On completion of the first two years of full time study, the student will have acquired sufficient knowledge and skills to join the computer industry as a Programmer. In the remaining years of part time study, the student will benefit from the mutual support of working experience and study of advanced topics in Computing[5].

Upon completion of Phase 1, students will be awarded a *Senior Diploma* and will engage themselves in full-time employment while taking part-time studies in the evening. The Senior Diploma, which signifies a recognition of graded achievement, provides diplomates and their potential employers with a common reference point of academic and professional standing for negotiating and determining an appropriate level of emolument.

This arrangement will stand the graduates in good stead, in terms of their long-term career development as well as short-term competition for a position of their own choice. This approach is also valuable to students in their learning process because the practical experience they gain in their full-time employment will improve the knowledge acquisition activities in the classroom during Phase 2. In sum, upon completion of their studies, students will have gained not only an honours degree but also a number of years of practical experience.

3.4 Curriculum Design

The design of the curriculum for Phase 1 (that is, Years 1 and 2) is critical, particularly in that it is required to meet two different criteria: to prepare students for the job market and to lay a solid foundation for further advanced work. This situation arises from the balancing of theory and practice in the sense that on the one hand potential employers demand a practical, applied preparation and on the other hand this must be supported by an appropriate theoretical foundation in order to continue into Phase 2 studies. The Phase 1 programme must be designed with these criteria in mind.

Furthermore, as the course aims to eventually produce graduates capable of becoming IS specialists, due emphasis on the subject of Information Systems itself is essential. Together with related topics through the electives, culminating in the final year project, the design meets the criteria and the graduates should be ready for a career as Information Systems professional with confidence and independence.

In the design process, the domain knowledge required by the curriculum in support of the adopted approach is arranged into three major groups. They are Computing, Complementary, and Supporting.

Computing Studies subjects are the *core* subjects that will provide students with a firm conceptual and theoretical foundation in Information Systems, and, together with elective and supplementary subjects, they form the backbone of the curriculum. *Elective* subjects are drawn from contemporary topics and those actually offered are consistent with the current expertise and interests of individual members of staff. *Supplementary* subjects are those which will strengthen the students' IS specialist knowledge. They include such topics as hardware technology, software technology, business and management, quantitative techniques, communication skills, and whole-person education.

Complementary Studies subjects fulfil the university's mission of *whole-person education*. For this curriculum, they consist of languages (English and Chinese), behavioural studies, religion and philosophy.

Supporting Studies subjects are auxiliary to the main thrust of the curriculum. Appropriate topics are selected from the Accounting, Business and Management areas.

Phase 1 will provide students with four major components: (a) the essential concepts, practices, functions, etc in the business world, with particular reference to Hong Kong; (b) the techniques and skills - both theoretical and practical - of the essential subject matters in the field of Computing including hardware-oriented, software-oriented, and applications oriented units of study; (c) the required analytical skills; and (d) the concepts of liberal education and philosophy of life.

Phase 2 will focus on the final preparation of the students for a professional career in the computer industry, or for the pursue of advanced studies in Information Systems. In the process, it also demands a sharpened focus of specialisation or a broader view of their professional career path through further studies in

5 Actual years of experience: Of the Applications Programmer positions filled, 19% of the occupants have "less than 1 year" experience, and 47% of them, have "1 year to less than 3 years" experience. [VTC 1989, section 2.15 and appendix 11]

subjects drawn from closely aligned areas.

For the curriculum as a whole, the syllabuses designed must contribute to foundation, development, consideration, and integration dimensions [Figure 3.4.1]: (a) *foundation* refers to the basic domain knowledge; (b) *development* is concerned with the subject matter which is accomplished by an intensive study of systems development techniques; (c) *consideration* intensifies the domain knowledge at an advanced level; and (d) *integration* is achieved through the Group Project which integrates the work up to the end of Phase 1, and the Honours Project, a dissertation.

(a) Foundation:
Structured Programming,
Programming Practice,
Data & File Structures,
Introduction to Information Systems,
Operating Systems,
Database Systems.

(b) Development:
Information Systems 1 (Analysis)
Information Systems 2 (Design)

(c) Consideration:
IS Theory & Methodology
IS Development Management
IS Management
IS Professional Practice

(d) Integration:
Group Project
Honours Project (Dissertation)

Figure 3.4.1

3.5 The Resultant Curriculum

An overview of the general structure of the resultant curriculum is shown in Figure 3.5.1. The schedule per level (year) in terms of subjects is given in Figure 3.5.2. The subject-flow of the curriculum, which demonstrates the interrelationship and linkage of the subjects (Computing subjects only), is depicted in Figure 3.5.3. This curriculum is comparable to the findings on educational needs of IS and End User personnel [Nelson 1991].

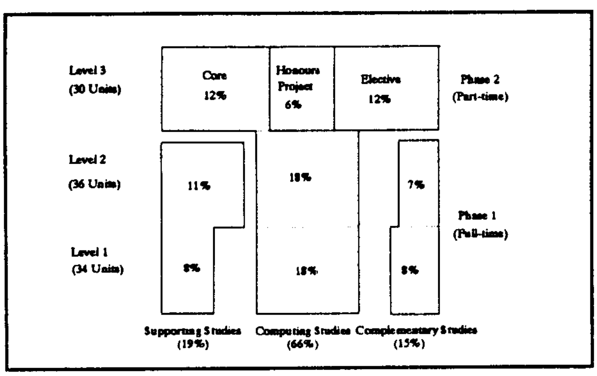

Figure 3.5.1 - General Structure of the Curriculum

Semester 1	Semester 2
Level 1 (Year 1)	
Business Orgn & Management	Programming Practice (PP)
Structured programming (SP)	Data & File Structures (DFS)
Introduction to IS (IIS)	Computer Systems (CS)
English	Information Systems 1 (IS1)
Chinese	Mathematical & Statistical Methods
Discrete Structures	Religion & Philosophy elective
Level 2 (Year 2)	
Financial Accounting	Management Accounting
Operating Systems (OS)	Quantitative Analysis
Database Systems (DBS)	Psychology of Work
Information Systems (IS2)	IS2 (Cont)
Group Project (GP)	GP (Cont)
Religion & Philosophy elective	Religion & Philosophy elective
	Basic Economic Principles
Level 3 (Years 3, 4, 5)	
IS Theory & Methodology (*)	IS Development Management (*)
IS Professional Practice (*)	IS Management (*)
Honours Project (HP)	HP (Cont)
Elective (**)	Elective (**)

(*) indicates core subjects
(**) includes, at the time of implementation, the following

Artificial Intelligence
Decision Support & Expert Systems
Discrete Simulation
Principles of Programming Languages
Distributed Database Management Systems
Computer Architectures
Computer Graphics
Information Systems Auditing
Information Systems Security
Object-oriented Design & Programming
Topics in Software Engineering

Figure 3.5.2 - Schedule

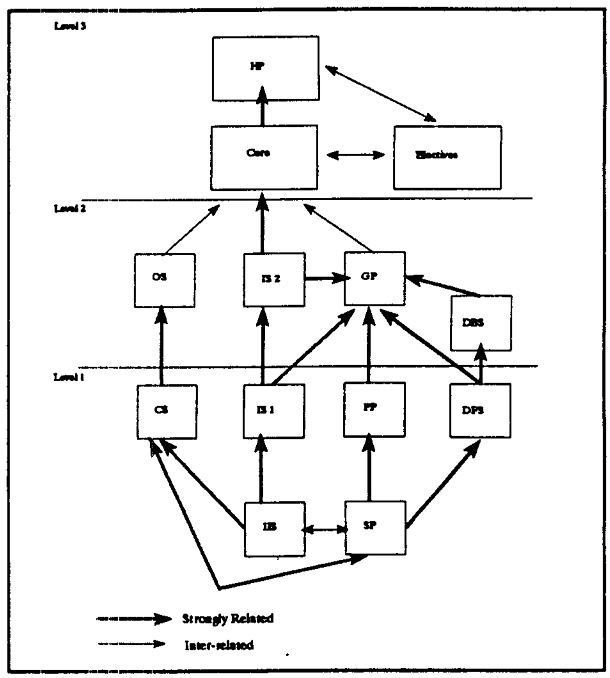

Figure 3.5.3 - Subject-flow of the Curriculum

4. EFFECTIVENESS OF THE DESIGN

4.1 General Observations

The mixed-mode, two-phase approach not only accelerates the production of the needed computing specialists, but also fits in very well with the pattern of employer-expectation and career-progression in the Hong Kong computer industry. [VTC 1989].

The major critical success factor for the curriculum was the affluent economy of Hong Kong during the period of 1989-1993 when employment was not a problem, and, at the same time, there was a high demand for the kind of expert manpower the curriculum was designed to produce. A secondary factor of success was the push by the foundation course leader - a veteran computer professional who has established a well-oiled relationship with the Hong Kong computer industry - to enlist willing supporters for the curriculum, to lead the course team through the validation exercise and obtain in the end approval for launching the programme, and to place at a later stage the Third Year students in appropriate employment. Yet another secondary factor of success was the willingness of the teaching staff in carrying out the relatively extraordinary teaching and administrative duties (in the Baptist University's usual terms of pattern and policy).

The design allows for a valuable learning process through which the practical experience the students have gained in their full time employment will enhance the learning activities in the classroom during the later part of the programme. At the end, the graduates are well equipped and are capable of contributing to closing the "skills gaps" [Broadbent et al 1992].

4.2 Survey of End Users - Graduates

A questionnaire was posted to the graduating class [6.2 Appendix 2]. The response rate was 60%. The data collected are shown in Table 4.2.

The results confirm that Honours Diplomates were able at the end of Phase 1 to enter the job market of own choice successfully, thus virtually fully employed and initially as a Programmer. However, Phase 2 is not as effective as indicated by the employers or as useful as expected by the course team.

The results also indicate a very low attrition in that 92% of students have graduated. This is a strong indication of acceptance by the most of students of the relatively lengthy duration of 5 years. The 8% were those who had emigrated with family, or continued further studies abroad.

Effectiveness of Design	Yes	No
Honours Diploma helpful in getting first job	87.5%	12.5%
Honours Diploma helpful in getting subsequent job(s)	87.5%	12.5%
P/T study helpful in securing a job	37.5%	62.5%
Degree helpful in furthering career goal	87.5%	12.5%
First job		
Programmer		100%
Analyst/Programmer		0%
Systems Analyst		0%
Others		0%
At graduation, employed as		
Programmer		62.5%
Analyst/Programmer		25.0%
Systems Analyst		10.0%
Postgraduate Work		2.5%
Frequency of changing jobs		
Once		12.5%
Twice		37.5%
Three times		25.0%
Four times		12.5%

Table 4.2 - Survey of Graduates

4.3 Survey of End Users - Applicants

Data collection from prospective applicants of the course - the final year high school students - was less structured.

At joint university admission sessions, students were selected at random. Those who agreed to an interview were given a short introduction to the course, and were then asked to respond to a few questions. The results do not give a clear indication, due largely to the quality of the survey. About 40 students were interviewed. The questions asked and the responses obtained are displayed in Table 4.3.

Given the brief introduction of the course, would you decide apply for admission to this course?	Yes	No
Decide to enrol	65%	35%
If you decide to enrol in this course, what you perceive as the merit of the mixed mode arrangement?	Yes	No
Acceleration of getting started in a job	80%	20%
After 5 years, got a degree and 3 years working experience	50%	50%
It gives the mutual support of learning/practising	60%	40%
If you decide not to enrol, what is your main reason?	Yes	No
Don't like the mixed mode	90%	10%
5 years a bit too long	95%	5%

Table 4.3 - Survey of Applicants

4.4 Hong Kong's Computer Science/Information Systems Curricula

Various models are adopted in the Hong Kong higher education institutions. The Baptist Model stands quite apart from the others. The four models [Figure 4.4.1] are summarised as follows: (a) the Traditional Model - 3-year full time post A-level at the institution (Hong Kong University, University of Science and Technology), or 4-year (Chinese University); (b) the Sandwich Model - 4 years in duration, comprising 1st, 2nd and 4th years full time study at the institution and an embedded full time industrial placement assignment in the 3rd year (Hong Kong Polytechnic University, City University); (c) the Lingnan Model - 3 years in duration, with full time study at the College during the first two and a half years, followed by a full time, well-defined industrial placement project during the second term of the final year at the sponsor's premises; and (d) the Baptist Model - 2-year full time study followed by 3 to 5 years part time study and simultaneous full time employment.

3 or 4 Yrs F/T	2 Yrs F/T	2 Yrs F/T	2 Yrs F/T
	1 Yr F/T placement	1/2 Yr F/T study	3 Yrs P/T study
	1 Yr F/T study	1/2 Yr F/T placement	& F/T work
Traditional	Sandwich	Lingnan	Baptist

Figure 4.4.1 - Various Models in Hong Kong

5. CONCLUSIONS

5.1 General Comments

The curriculum was claimed as "unprecendented" has been presented. The presentation provides first of all an overview of the curriculum, showing its features of innovativeness [section 2] and demonstrating that the design and implementation follow in general a systems approach [section 3], and finally a review of the effectiveness of the curriculum [section 4].

The curriculum has been shown to be innovative, not only because it was commended as such but also because of its mixed mode of attendance and the associated supporting arrangements.

The design process starts with an examination of the required knowledge base in terms of core, elective and supplementary subjects. The process then continues with the mapping of these subjects onto the foundation, development, consideration and integration aspects of the curriculum while, at the same time, categorising them into Computing subjects, Complementary Studies subjects and Auxiliary subjects. Finally, the process concludes by a fine-tuning of the Computing category as Information Systems oriented (main thrust), hardware and software oriented, and elective subjects.

The design has been shown to be effective. Over 90% of the students successfully complete the programme and virtually all have been employed, not only during Phase 2 but also at graduation.

The curriculum undertook its revalidation recently (after the second validation in 1991). This has provided the course management team and the university with an opportunity for a critical review and self-assessment. The curriculum has now been changed from a mixed mode to a three-year full-time mode only. This decision is heavily influenced by the variable success factors mentioned above. The decision is also influenced by the students' changed preference to favour "the quicker and sooner to complete the degree, the better", due to the approaching of 1997 when sovereignty changes hands.

5.2 Limitations

There should be three groups of end users with respect to a curriculum, viz, the potential employers of the graduates, the potential applicants to the course, and the students of the course. However, the end user in this exercise only included the potential employers, because, prior to implementation, it was only possible to identify and work with them as one of the groups. The survey and interview could, therefore, be directed to, and hence the data collected represented the opinions and expectations of, only this group. For this reason, the design had the benefit of input from only one category of end users.

On the basis of the survey of graduates, the curriculum design team has successfully accomplished its mission. However, the success of the design is so closely dependent on those critical success factors (4.1) that its stability is questionable.

5.3 Future Study

In future curriculum design, not only the three groups of end users, but a fourth group - the relatives including Mums and Dads, Uncles and Aunts, etc, and friends - should be included in the survey.

6. APPENDICES - DATA COLLECTION

6.1 Appendix 1 - Survey of Potential Employers

Composition/length of experience of local EDP work force

Rank		Years of experience				Total
		0-1	2-3	4-5	6->	
Manager	%	0.0	1.6	2.8	95.7	575
Systems Analyst	%	0.6	13.6	42.3	43.5	1030
Programmer	%	39.9	35.4	17.1	7.7	2404
Overall	%	24.0	24.9	21.5	29.5	4009

Educational level/computing training of Programmers

Educational level		Computing training		Total
		Formal	Informal	
Degree	%	90.1	9.9	1571
Non-degree	%	80.1	19.9	832
Overall	%	86.6	13.4	2404

Employer preference

Preference	%
Sub-degree holder	9.8
Degree holder	50.0
No preference/Undecided	40.2

Employer opinion - staying on the job

Opinion	%
Degree holder more like to stay on	12.4
Sub-degree holder more likely to stay on	53.0
No idea/Undecided	34.6

Employer opinion - becoming productive quickly after recruitment

Opinion	%
Degree holder more likely	32.0
Sub-degree holder more likely	17.3
No idea/Undecided	50.8

Employer opinion - prospective continuing students vs other inexperienced sub-degree holders

Opinion	%
Prospective continuing students	
- more favourably	26.3
- less favourably	16.5
- equally favourably	57.1

Employer opinion - prospective graduates' pre-degree experience (3 years) vs post-degree experience (2 years)

Opinion	%
Pre-degree experience considered longer	19.9
Pre-degree experience considered equivalent	59.0
Pre-degree experience considered shorter	13.2
Pre-degree experience not considered at all	2.6
No idea/Undecided	5.3

Company policy on part time study in Computing by non-degree EDP staff members

Opinion	%
Encourage P/T study	79.3
Neutral if not interfering with normal work	17.3
Do not encourage P/T study	0.8
No idea/Undecided	2.7

Employer opinion - Years 1 & 2 Subjects

Questions	Response (%)			
	[1]	[2]	[3]	[4]
1.1	70.3	29.3	0.4	0.0
1.2	44.0	51.5	3.8	0.8
1.3	38.7	57.5	3.4	0.4
1.4	45.1	48.9	5.6	0.4
2.1	16.5	59.0	22.6	1.9
2.2	17.3	71.8	10.5	0.4
2.3	20.7	58.3	19.9	1.1
3.1	16.9	61.7	19.9	1.5
3.2	11.7	55.6	28.9	3.8
3.3	2.3	20.7	68.4	8.6
3.4	4.5	40.6	48.9	6.0
4.1	43.6	36.8	16.5	3.0
4.2	10.2	53.4	34.2	2.6
4.3	8.3	52.3	38.0	1.5
4.4	21.4	67.7	10.2	0.8
4.5	14.7	57.9	25.2	2.3
4.6	10.5	54.1	29.7	5.6
4.7	15.4	57.1	24.1	3.4
4.8	7.9	44.0	41.7	6.4
4.9	9.4	50.4	35.3	4.9
4.10	1.1	25.2	66.9	6.8
4.11	3.8	12.4	71.1	12.8
5.1	16.2	42.5	37.6	3.8

Note: [1]=most important;
[2]=important;
[3]=unimportant;
[4]=undecided.

Questions :

1. General qualities:
1.1 Logical thinking
1.2 Analytical ability
1.3 Cooperativeness
1.4 Team work spirit

2. Language and communication abilities:
2.1 Communicate effectively in oral English
2.2 Communicate effectively in written English
2.3 Communicate effectively in Chinese

3. Business or commercial knowledge:
3.1 Basic principles of business
3.2 Basic principles of accounting
3.3 Basic principles of economics
3.4 Elementary statistics for business

4. Technical abilities and knowledge:
4.1 Ability to write programs in COBOL and RPG
4.2 Ability to write programs in other high-level languages
4.3 Ability to use popular software packages
4.4 General knowledge of computer systems and architecture
4.5 Knowledge of computer security, control and audit
4.6 Knowledge of recent computer technologies
4.7 Knowledge of system development and management
4.8 Knowledge of management decision support systems
4.9 Knowledge of software engineering concepts
4.10 Knowledge of artificial intelligence and expert systems
4.11 Knowledge of CAD or CAM

5. Others:
5.1 Knowledge of machines the company is currently using

6.2 Appendix 2 - Survey of Graduates

Name ____________________
Contact Address (Work) ____________________
____
(Home) ____________________
____

Contact Tel/Fax (Work) ____________ (Tel)
____________ (Fax)
(Home) ____________ (Tel)
____________ (Fax)

Has the Hon Dip been helpful in hunting for your first job? Yes/No
Your subsequent job? Yes/No
Has the P/T years been helpful in securing your job or jobs? Yes/No
Will the degree be helpful in furthering your career ladder? Yes/No

Your current job:
Position _______ Employer _______ Started Date _______
[Enclose a business card, if you have one available.]

Your past jobs (since 1990/91):
Position _______ Employer _______ When Started ______
Position _______ Employer _______ When Started ______
Position _______ Employer _______ When Started ______
Position _______ Employer _______ When Started ______
Position _______ Employer _______ When Started ______

When complete, please return to:
Wanbil Lee, Dept of Computer Studies, Lingnan College,
15 Stubbs Road, Hong Kong

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GRAPHICS-ORIENTED PROJECTS IN SOFTWARE ENGINEERING

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ABSTRACT

A common problem in software engineering courses is the selection of a meaningful and realistic software development project that will achieve the desired goals subject to the given time constraints. This paper proposes that a Graphics-Oriented Project (GOP) can readily meet the requirements of an appropriate project. The discussion focuses on the goals of a software engineering project, the project assignment and the aspects and advantages that a GOP offers. An example GOP is also discussed and several possibilities for other graphics-oriented projects are suggested.

INTRODUCTION

Software engineering courses have become a fairly common requirement in computer science programs since the "Denning Report" in [Denning 1989] and the subsequent Computing Curricula 1991 described in [ACM 1991]. Many times, the goals and the approach are much the same, for example, see [Lederman 1994, Lodgher 1991, Sigman 1992]. Ninety-five percent of those responding to a survey required a project in their software engineering [Mynatt 1987]. A common problem is the selection of a realistic project that has the appropriate components and is do-able in the given time frame [Mitchell 1991].

We teach a two-semester sequence in software engineering at Louisiana State University in Shreveport (LSU-S) using [Sommerville 1992]. This is a required capstone senior experience which is designed so that our students can:

- study and apply the concepts and principles of software engineering, and
- synthesize and apply much of their previous knowledge and experience in computer science by working in teams to simulate industry's approach to system development.

Concepts and principles of software engineering are presented during the first semester. Also, a CASE tool is demonstrated. We divide the class into teams and during the first semester the teams are required to select a real-life project subject to approval by the instructor. The teams do a system definition, a development plan, and client-level requirements. The second semester is devoted principally to the completion of the project. The teams design, implement, test, document and present their completed system. There are several benchmarks during the second semester and the teams are required to make a presentation at each benchmark.

THE PROJECT ASSIGNMENT

The goals of the project are to provide a significant systems development effort that will require the students to apply the concepts and principles of software engineering in the complete software life cycle, to provide an opportunity to work on a system with multiple components rather than the smaller program assignments which they have principally had, and finally to work in a team environment which simulates the approach that industry takes in software development. A complete project assignment to accomplish our goals is given in the Appendix. An abbreviated outline is as follows:

Identify a software development project and prepare a System Definition, a Project Plan, a Software Requirements Specifications, Design Document, Integration Plan, System Test Plan, Source Code Listing, User's Manual, and Project Legacy. The total effort for the overall project should involve about 4 to 8 person-months and about 2000 to 4000 lines of Pascal source code (including comments), or the equivalent. However, for the first course, students are required to only turn in the first three parts mentioned above. Use the EasyCASE software package to develop the data dictionary, data flow diagrams, and entity-relationship diagrams.

I. System Definition (3 to 6 pages).

The system definition briefly describes the proposed system from the user's (or requester's) point of view. It primarily describes the capabilities of the proposed system in terms of the problem to be solved and should be in language which the user/requester can understand (i.e., avoiding computerese). Also, students must avoid describing (in this part) how the system will be implemented. Very little, if any, is stated (in this part) about how the system will appear to the user or how it is structured.

II. Project Plan (3 to 8 pages).

The project plan should describe the plan and approach to completing the project. It should include a list of activities and tasks to be completed with specific deadlines. As a project evolves this schedule would normally be refined and changed. However, it is important that a specific (perhaps imperfect) plan be formulated in writing.

III. Software Requirements Specification (8 to 15 pages).

This software requirements specification briefly specifies in some detail the appearance and behavior of the proposed system. It describes how the system will behave, but does not state how it will be implemented. This document gives both the users/requesters and system designers/implementers a clear idea of what the system will do for the user, but leaves the design of how the system will accomplish its various functions unspecified.

IV. Design Document (approximately 20 to 40 pages).

This document specifies in increasing detail the structure of the implementation of the proposed system. This includes data files and data structures as well as the modularization of the system and specification of algorithms to be used. This document stops just short of producing actual code.

V. Integration Plan and System Test Plan (approximately 7 to 15 pages).

1. The Integration Plan should state as precisely as possible how, and in what order, the modules are going to be combined and tested (integration testing). That is, it should specify the stages of integration of modules and the tests to be performed at each of these stages.

2. The System Test Plan should specify the tests to be performed on the complete system. For both plans, specific test cases should be specified. Note that some, if not most, test cases can be used for both integration and system testing. Specify the test cases as described below and refer to them by name or number in the sections above.

VI. Source code listing (approximately 20 to 50 pages).

The source code listing should be well organized and exhibit good coding style. It is especially important that the code be commented well. The author of each section of code as well as its purpose should be clearly identified.

VII. User's Manual.

The user's manual should present all information needed by the intended users to use the system in an effective manner. The format of this document is left to the discretion of each team.

VIII. Project legacy (4 to 10 pages).

The project legacy should briefly state the background of the project as well as describe its current state. It should also provide information useful to anyone expected to maintain, modify or enhance the system.

It is readily apparent from the project goals and the outline of the assignment that this is a time-consuming and a comprehensive undertaking. We have considered requiring a three semester sequence in software engineering as described in [Mitchell 1992]. In the meantime the use of a graphics-oriented project helps to make the two-semester time-frame workable.

GRAPHICS-ORIENTED PROJECTS

A Graphics-Oriented Project (GOP) may be readily described and defined in terms of its graphical components, the desired drawing capabilities and the relationships of the components and the drawing capabilities. These graphical components and the drawing capabilities provide an opportunity to define the project requirements visually which greatly aids in the understanding of the project. There is latitude for adding or subtracting components or features according to the time constraints.

A GOP permits ready use of multiple levels of menus and an opportunity to provide user-friendly pop-up or pull-down menus. There is also a need to design screens with drawing areas, command areas and icons. The students will gain valuable experience with windowing concepts and windows application development.

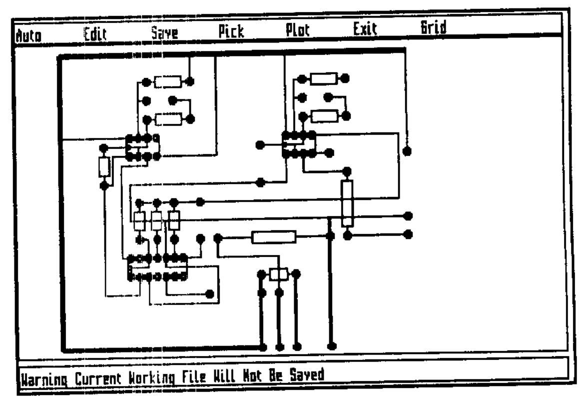
A GOP provides the students with experience in developing a Graphical User Interface (GUI). This will aid their understanding and appreciation of this valuable user-friendly interface.

A GOP has multiple components which permits easy division of the development among the team members. This modularity lends itself to object-oriented design and implementation. The graphical objects lend themselves to the use of inheritance.

A GOP provides the opportunity to add the feature of saving the graphical images as files. These files may be re-called and the graphical images may be further edited or enhanced and re-saved or displayed.

AN EXAMPLE

An example of a GOP that one of our team of students developed is "The Design of A Printed Circuit Board". This project provides the capabilities of drawing a printed circuit board, saving the drawing and recalling the drawing for presentation or further editing. The project provides drawings with three different wire thicknesses, capabilities of inserting components, deleting components, and zooming or shrinking the drawing. Selection options of components, holes, or wires, may be made. The options for components are: resistor, capacitor, inductor, diode, transistor, IC chips, crystal, transformer, battery and jumper. An interesting feature permits the user to select two points with the program finding a non-overlapping path for a wire between these points. The final circuit can be plotted out on a plotter. The main menu and an example drawing are as follows:



This example GOP had a menu-driven design and implementation with a friendly user interface. Further, this example provided the proper structure and components and had all of the desired features to meet the goals of the project assignment. Several other GOP possibilities are:

a 2-dimensional image editor,
a foreign language word processor,
an interactive computer game,
a computer architectural tutorial, and
a wire-frame modeler.

CONCLUSION

Software engineering courses have become a common requirement in computer science curricula. Most of these courses require a senior software development project. A common problem is the selection of a realistic project that complements the theory and helps to accomplish the goals of the project requirement subject to the given time constraints. An example of a graphics-oriented project, "The Printed Circuit Board", was presented in some detail. Several other possible graphics-oriented projects were listed.

This paper has proposed that graphics-oriented projects have the great potential of providing appropriate and realistic projects. The authors have successfully used GOPs in some of the software engineering courses that they have taught. More details on the example GOP described in this paper and other graphics-oriented projects are available by contacting the authors.

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APPENDIX

THE COMPLETE PROJECT ASSIGNMENT

Identify a software development project and prepare a System Definition, a Project Plan, and a Software Requirements Specifications, Design Document, Integration Plan, System Test Plan, Source Code Listing, User's Manual, and Project Legacy. The total effort for the overall project should involve about 4 to 8 person-months and about 2000 to 4000 lines of source code (including comments), or the equivalent. However, for the first course, students are required to only turn in the first three parts mentioned above. Use a CASE tool to develop the data dictionary, data flow diagrams, and entity-relationship diagrams.

I. System Definition (3 to 6 pages)
The system definition briefly describes the proposed system from the user's (or requester's) point of view. It primarily describes the capabilities of the proposed system in terms of the problem to be solved and should be in language which the user/requester can understand (i.e., avoiding computerese). Also, students must avoid describing (in this part) how the system will be implemented. Very little, if any, is stated (in this part) about how the system will appear to the user, or how it is structured. This document includes the following sections:
1. Brief statement of the problem to be solved and why.
2. Functions (capabilities) to be provided by the proposed system including additional capabilities.
3. Processing environment: specific hardware and/or software that is used.
4. User characteristics (abilities, knowledge, experience, frequency of use, etc.).
5. Sources of information (people, books, manuals, etc.)
6. Glossary of terms, if appropriate, including only terms needed to state the problem or its proposed solution. Only terms that are used in a way other than their standard English meanings are included. Technical computer terms are not included unless they are needed to describe the problem or its solution. The goal is to state the capabilities that the proposed system will provide, and not how the system will work.

II. Project Plan (3 to 8 pages).
The project plan should describe the plan and approach to completing the project. It should include a list of activities and tasks to be completed with specific deadlines. As a project evolves this schedule would normally be refined and changed. However, it is important that a specific (perhaps imperfect) plan be formulated in writing. Sections this plan includes are:
1. Developmental schedule: milestones and work products, with deadlines and responsibilities, containing more detail than just due dates.
2. Programming languages, development tools, and computer facilities to be used to carry out the project.
3. Estimates of the time required, personnel needed and cost of the project. These may not be very accurate, but the experience of estimating the costs is educational. Students use $25 per hour for their time. They give the hourly rates of any others involved in working on the system plus the total hours and associated costs.

III. Software Requirements Specification (8 to 15 pages).
This software requirements specification briefly specifies in some detail the appearance and behavior of the proposed system. It describes how the system will behave, but does not state how it will be

implemented. This document gives both the users/requesters and system designers/implementers a clear idea of what the system will do for the user, but leaves the design of how the system will accomplish its various functions unspecified. This document includes each of the following sections (if appropriate):

1. Product summary and overview (can be extracted from system definition).
2. System environments (for development and for completed system usage).
3. Conceptual model of proposed system
   a. Data flow diagrams
   b. Logical data sources and sinks
   c. Logical data stores (files)
   d. Data dictionary - This is a list of all data (information) items that enter, exit or flow inside the system. Information for each item is provided as follows:
      - name of item
      - meaning or purpose
      - value restrictions and interpretations
      - structure and subitems, if any

   All subitems are, in turn, added to the dictionary as items.
4. Functional specifications (from system definition, expanded). This may be negotiable if the project seems too large or too small.
5. Performance requirements/constraints (speed, storage required, etc.)
6. Acceptance criteria - This is a checklist of checks and tests to be made (and passed) on the final version of the system before it is released to the requester (and turned in to the instructor). This includes checks on the quality of documents and quality of source code as well as functional and performance tests on the completed system.
7. Sources of information (from system definition).
8. Glossary of terms (from system definition, expanded).

IV. Design Document (approximately 20 to 40 pages)

This document specifies in increasing detail the structure of the implementation of the proposed system. This includes data files and data structures as well as the modularization of the system and specification of algorithms to be used. This document stops just short of producing actual code.

1. External Interfaces
   a. User displays and report formats
   b. Menus and/or command summaries
2. Architectural Design
   a. Data file descriptions
      1. Name
      2. Organization (sequential, relative, indexed)
      3. Method of access, key fields
      4. Record layout
   b. Global data structures
   c. Structure chart of modularization
   d. Description of modules used but not written by the team
   e. Description of each program module
      1. Name
      2. Purpose or function
      3. Description of parameters.

Note: If an object-oriented approach is used, the architectural design will consist primarily of object class descriptions and specifications. Inheritance and assembly structures would be described as well as client-server relationships between classes.

3. Detailed design of each major program module (or class method)
    a. Name
    b. Purpose or function
    c. Description of parameters
    d. Global variables/structures referenced/changed
    e. Local data structures
    f. Pseudocode.
        - The particular pseudocode rules/standards used by the team should be stated at the beginning of this section; most modules should be pseudocoded.

V. Integration Plan and System Test Plan (approximately 7 to 15 pages).

1. The Integration Plan should state as precisely as possible how, and in what order, the modules are going to be combined and tested (integration testing). That is, it should specify the stages of integration of modules and the tests to be performed at each of these stages.
2. The System Test Plan should specify the tests to be performed on the complete system. For both plans, specific test cases should be specified. Note that some, if not most, test cases can be used for both integration and system testing. Specify the test cases as described below and refer to them by name or number in the sections above.

    A description of a test should include, or indicate by context, the following:
    a. Purpose of test
    b. Any assumptions made
    c. Exact (specific) test input data
    d. Exact outcome or behavior expected

VI. Source code listings (approximately 20 to 50 pages)

The source code listing should be well organized and exhibit good coding style. It is especially important that the code be commented well. Do not put comments in last. The author of each section of code as well as its purpose should be clearly identified.

VII. User's Manual.

The user's manual should present all information needed by the intended users to use the system in an effective manner. The format of this document is left to the discretion of each team.

VIII. Project legacy (4 to 10 pages)

The project legacy should briefly state the background of the project as well as describe its current state. It should also provide information useful to anyone expected to maintain, modify or enhance the system. It should include the following sections:

1. Project background and overview (probably extracted from other documents)
2. Current status of the project.
3. Area of concern (bugs and messy or inefficient modules).
4. Record of time spent on various phases of project; include total time.
5. Technical lessons learned.
6. Managerial lessons learned.
7. Recommendations for the future of the system.

'REAL LIFE' CASE STUDY PROJECTS TO FACILITATE STUDENT LEARNING IN BUSINESS INFORMATION SYSTEMS: A COURSE MANAGEMENT APPROACH

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Abstract

This paper presents an approach for supervising 'Real Life' Case Study projects. The aim of using a case study approach is to enhance student learning by allowing students to gain actual work experience with their selected client. Difficulties encountered by the project supervisor in monitoring the project are discussed. The current strategies of project supervision and a proposal on how to further improve the effectiveness of student learning are also described.

Introduction

No single teaching strategy is superior to another, the effectiveness of each strategy to facilitate student learning will depend on various factors such as available resources and the characteristics of students. One of the disadvantages of teaching strategies typically used in Business Information Systems (BIS) curricula is a failure to provide 'real life' employment experiences where students are exposed to the numerous and uncontrollable variables which characterize systems analysis, design and implementation projects in organizations.

Background

The Department of Business Systems, which aims to provide a systematic study of BIS and the applications of computer technology to a range of business and administrative areas, realizes the importance of incorporating real life experience in student learning. As a result, a one-semester (14-week) 'real life' case study project is scheduled in the second year of the Department's Diploma in Computer Applications course. The aim of this subject is to provide students with an opportunity to gain practical experience through dealing with a client for the purpose of analyzing, designing, implementing and/or evaluating a computer-based information system. To undertake this subject, students are required to find a client and work on a system in their workplace. Under normal circumstances, group work is preferable and students are formed into teams voluntarily. Except for a two hour orientation in the first week, this subject currently has no formal lecture and tutorial components, however, compulsory and optional consultations with the supervisor are arranged throughout the semester.

Before the adoption of a 'real life' case study approach, the Department considered other available alternatives, including:-

- Student Placement in Outside Organizations
  This alternative will benefit students through gaining experience with standardized work practices, organizational culture and politics, and becoming proficient in their assigned job. e.g. maintaining COBOL programs for Accounting Systems. Practically speaking, difficulties in implementing this alternative are:-
  - our University is a regional University, with a limited pool of local potential employers,
  - as a relatively new Department, the network of potential employers is still being developed,
  - the distances involved may preclude many local students from travelling to other cities in order to participate in a student placement scheme,
  - as students normally undertake two to four subjects in one semester, a half-year full-time placement will alter the duration of the course,
  - without employer's support, it would be impossible for the part time students, who are currently working, to participate in this scheme,
  - the experience and skills of students varies greatly, and it would be time-consuming for the supervisor to assign the right students to the right jobs.

- Constructed Case Studies
  An alternative to a field based case study is the use of a 'textbook'-based case study. If case materials are well-documented, this may be an useful substitute for a 'real life' case study (Ronstadt 1992, 5). One of the advantages in using a textbook case study is that it enables a well-prepared supervisor to direct students working on a pre-determined approach, thus it is more controllable. Case studies lack realism for students who are unfamiliar with business practices, have difficulty in understanding organizational politics, and do not know very much about technical issues.

- Computer-Based Interactive Constructed Case Studies
  This alternative has been pioneered at the Copenhagen School of Economics by Niels Bjorn-Andersen (State of the Art in Information Systems - video report 1993), who developed a video disc based 'virtual organization'. Case studies are categorized by topics and students can retrieve any case for discussion purposes. However, this alternative would only be feasible if the Department had sufficient laboratory resources and funding.

How a 'Real Life' Case Study Enhance the Student Learning Process

Gagne's Learning Model (Gagne 1974, 25 - 47) will be used to illustrate the value of using a real life case study project to facilitate student learning. The model presents eight phases.

Motivation Phase
Foreseeable incentives motivate learners who in turn direct their effort in achieving pre-set goals. Students are motivated since the project provides them with an opportunity to test their acquired skills and knowledge from the other subjects completed in their course. In addition, this project is a solid piece of work to show their expected employers when it comes time to look for a job.

Apprehending Phase
In this phase, learners select stimulation which is related to their learning purpose. Project work exposes students, often for the first time, to the reality of work in organizations. This includes exposure to multiple, and often contradictory opinions on various topics relevant to systems development, experience with the resolution of conflicting viewpoints, development of new design alternatives, and provides students with a formative first experience of the richness of the workplace. Consequently this broadens the view of the students.

Acquisition Phase
Stimulation which has been decoded will enter the learner's short-term memory. Successful knowledge acquisition follows when students are able to appreciate the application of various system development methodologies, hardware and software.

Retention Phase

Retention is possible when the knowledge and skills acquired are stored in long-term memory. In comparison with formal lectures, the case study project allows students to work with minimal intervention by the supervisor. This encourages long-term knowledge retention as students are not considered to be passive receivers (Print 1988, 127).

Recall Phase

Knowledge retrieval from long-term memory is exhibited in the recall phase. When students are actively involved in the learning process, recall is not restrained to the current sources of information, but actually extends to their knowledge base which has been established previously, incorporating the skills and knowledge they have acquired in previous subjects (Cole & Chan 1994, 404).

Generalization Phase

Learners' ability to apply the correct skills and knowledge to solve problems highlights success in the transfer of learning. Learners are aware that they are using these skills and knowledge in a different context. The real life case study project provides clear evidence of the student's ability to generalize the application of previous skills and knowledge.

Performance Phase

Learners organize what has been learned for demonstration purposes. In this case study project, students submit three written assessments: (1) an initial project plan; (2) a progress report; and (3) a final report; plus an end-of-semester oral presentation. These could be considered as learning milestones as well as performance reviews. These assessments also have the advantage of mimicking the milestones used in the application of systems development methodologies.

Feedback Phase

Demonstration of acquired skills and knowledge leads to feedback from other parties. There are three parties involved, student, client and supervisor, and each party has their distinct expectations for the project. Students are provided sufficient feedback to encourage them to reflect on their progress, which is very important in adult learning (Brockett 1991, 89).

The Value of the Project to Different Parties

Although all the parties see value associated with the project, their value sets are different. The following are some of their different expectations:-

- Students
  - gaining experience in the workforce,
  - translating theory into practice,
  - preparing for future employment,
  - improving interpersonal skills,
  - increasing understanding in other subjects,
  - experience in working with other people. e.g. fellow students, client, supervisor,
  - independently producing a computer system (Centre for Staff Development - Teaching Evaluation Report 1994, 5 - 7),
- Client
  - a 'free-of-charge' system is produced,
  - an outsider analyzes their current system and work practices and assists in improving their business,
- Supervisor
  - an opportunity for students to obtaining 'real life' experience,
  - a solid piece of work to increase student employment opportunities,
  - translating theory into practice,
  - verify the student's ability to integrate various skills and knowledge acquired in other subjects offered in their course,
  - experience in working with other people,
  - students have to justify their choice of actions,
  - students learn to work under various constraints. e.g. resources, time.

From the above summary, we note that the value sets of the student and the supervisor are quite similar. The client's value set is much more product/service-oriented, without much reference to the enhancement of student learning.

Difficulties in Supervising the "Real Life" Case Study Project

In addition to the involved parties having sometimes quite different expectations, other constraints exasperate the difficulties in supervising these projects. The following are some of the most common difficulties:-

- Resource Limitations
  Most students, except for those who have equipped themselves with the necessary hardware and software, will encounter this problem. The common forms of resources constraints are:-

  - Access to Computing Resources
    Due to the intense demand for computer laboratory resources, the Department has set aside a three hour laboratory session each week for students to work on their projects. For students who have no computer at home or do not have the necessary software, additional hours will be needed in the laboratories to access specialized development environments and tools.
  - Financial Constraints
    No additional hardware or software resources, outside those which are already provided for teaching purposes, are provided to support project students. Students are not supposed to receive any 'consultation fee' from their clients. They have to make their decisions based on the resources available.
  - Expertise
    Students have to be prepared to handle industry-related problems themselves or refer them to their client, the supervisor can only assist the students with the overall approach to their projects. The same applies to problems that arise from the use of special computer equipment or software.

- Characteristics of the Client
  Sources of clients for projects varies, and most of our clients are small business proprietors, who may be relatives or friends of the students, or simply make this arrangement after students' 'cold canvas'. Usually the clients have limited or no knowledge of how to use computers. It would be quite impossible for most clients to develop computer based solutions without considerable helps. It is quite common for clients to exhibit poor business practices and this is often identified by students. Most of the clients are very helpful, but some of them are not really committed, especially when it comes to the need for capital investment.

- Standard and Background of Students
  All the students have completed the first year of their Diploma course. Most students are High School leavers, and the rest are employed mature-age students. Work commitments usually discourage the working students from working as a group, while the full-time students often work in groups of four to five people. The students' acquired skills and knowledge also varies, and it is difficult to find a standardized supervisory approach to address the needs of all students.

- Nature of Project Selected
  There are two popular types of BIS case study projects:-
  - those involving a complete systems development where students are required to develop a BIS for the client by following an appropriate systems development methodology
  - a partial systems development where students are not required to complete a full-system. They may perform detailed systems analysis and design for a large system, select commercial packages to satisfy a client's needs after proper investigation, or even study an organization's problems related to defining basic information requirements

  As different stages in systems development have different objectives and employ different methods, it is difficult to provide standard guidelines to students undertaking complete and partial systems development tasks.

- Different Parties, Different Values
  - Student Vs. Client
    These two parties will normally not conflict because most students have no difficulty in delivering a product/service to the client. The

questions which need to be addressed are:-

- has the 'right' product/service been delivered? Has this product/service solved the 'real' problem?
- have students discovered any problem in the client's current work practices/computer systems which should be addressed with new systems development efforts? If students cannot address the problem properly, why? To what extend has the students attempted to solve this problem?

- Student Vs. Supervisor
  Both parties share common expectations. However, the supervisor's expectation that 'students should justify their choice of actions' is not often fully acknowledged by students. There may be a communication breakdown between these two parties when: (1) the supervisor fails to emphasize this justification issue; (2) even when the message has been successfully passed on to the students, they continue to find it difficult to justify what they are doing. This communication breakdown often leads to student grievances, especially when their final grade is lower than expected.
- Client Vs. Supervisor
  These parties often have little in common and communication is generally minimal and limited to the client's feedback on project performance. Also, facilitating student learning may not be the most important principle on the client's mind.

Current Strategy for Supervision

In order to prepare students to work on projects, the following strategies are employed by the supervisor:-

- Orientation
  A two hour orientation for project students is held in the first week. The purposes of this orientation are:-
  - to explain the aims and objectives of the project,
  - to notify students of supporting facilities which are available such as consultation times and available hardware and software,
  - to explain the components of assessment. eg. general and specific guidelines on each assessment component and distribution of marks,
  - to facilitate the formation of case study groups,
  - to check whether students have found a client for themselves.

  As there are no formal lectures and tutorials associated with this subject, this orientation will serve as a means to explain in a general sense how the project should be approached.

- Consultation Time
  There are two types of consultation available: optional consultation and compulsory consultation. Students can make appointments with the supervisor whenever necessary (optional consultation). Compulsory consultation is for students to collect their initial project plan and progress report. As a result, compulsory consultation becomes a semi-formal gathering between students and the supervisor, the purpose is to communicate progress and at the same time, the supervisor can suggest possible ways for improvement (Jacobsen et al 1985, 303).

- General & Specific Guidelines
  A set of general and specific guidelines is attached to the subject outline which is distributed to all students. The general guideline covers the formatting requirements for all the written assessments, eg. referencing methods, information required on the cover sheet. The specific guideline provides a list of systems development related items to be included in written assessments (eg. problem definition, cost benefit analysis) and a section on the requirement for oral presentation. If necessary, students are allowed to make changes in the specific guidelines when they are working on their assessments. The purpose of having specific guidelines is:-
  - providing students an approach to follow,
  - allowing students to consider whether this set of guidelines is workable in their case and if not, what sort of changes should be carried out in order to fit the project requirement.

- Assessment at Different Stages
For the sake of checking students' progress throughout this 14-week semester, three written assessments and one end-of-semester oral presentation are required.
    - Initial Project Plan (end of Week 2)
    Apart from the client's personal details, this assessment outlines the current computer/manual system-in-use, the proposed system, initial approach to systems development, proposed time schedule. This information will give the supervisor a general picture on how much progress the student has made with the client.
    - Progress Report (end of Week 6)
    This report serves as a check point for student progress in the mid semester. The specific guidelines for this report monitor activities and indicates whether students are working at an acceptable pace. For example, for students who attempt a complete systems development project, they should have almost finished systems analysis and design by mid semester.
    - Final Report and/or Software (Week 14 - Presentation Day)
    This assessment includes all the information covered in the previous assessments, together with the actual systems developed or recommendations for a suitable commercial package. Other documents, such as user manuals, testing data and testing results, are attached to this report. This report is the full set of documentation for the system.
    - Oral Presentation (Week 14 - Presentation Day)
    Students will demonstrate and justify their approach to build the system to an audience of Department staff. The presentation time is 30 minutes for individuals and 45 minutes for groups, including a questioning period.

- Case Study Projects from Previous Years
Students are allowed to borrow the Final Projects which have been done previously by other students. This enables students to learn how other students approach the project.

How to Evaluate the Case Study Project Curriculum

Tyler's Objectives Model on curriculum evaluation (Brady 1992, 258) may be applied to evaluate the aims and objectives set for a case study project subject. The five major areas covered by Tyler's Model where applied to the aims and objectives of our previous project subject description resulting in modifications described below.

- Are the Objectives Clearly Stated?
The current subject aim and objectives have not highlighted the supervisor's requirement for students to justify their choice of actions. The following is the revised version of the subject aim and objectives.
The revised aim is:-
To provide the students with an opportunity to gain practical experience in Information Systems areas through dealing with a client. Students should be able to justify their recommendations in evaluating/developing/managing a system.
The revised set of associated objectives is:-
On completion of this subject, students will have:-
    - applied their skills and knowledge of systems evaluation/development/management with a selected client,
    - gained practical experience in systems planning, analysis and implementation under real life situations,
    - gained experience in applying interpersonal and communication skills through interaction with clients, supervisor and group members,
    - obtained proficiency in report writing and oral presentation.
    These revised objectives shift students' attention to 'why they did it' instead of 'what they have done'.

- Is the Content Appropriate to Attain the Objectives?
The revised version of the subject aim and objectives increases students' awareness on the necessity to justify on what they are doing, however, its effect on the client is minimal. In order to convey the supervisor's expectation to the

client, the client-supervisor relationship need to be strengthened.

- Strengthen Client-Supervisor Relationship
  The drawbacks of having a loose client-supervisor relationship are:-
  - the client will seldom notice our 'existence', which can be interpreted as the supervisor having little interest in the client,
  - the supervisor limits his/her chance to help the client to understand the nature of the project, especially when most of the clients have limited knowledge of using computer,
  - the supervisor cannot detect the level of commitment of the client

  By prior arrangement with students, the supervisor should make a call to the client in the second week, explaining the purpose of the project, ways the client can help and to thank them for their assistance. This will lessen the drawbacks noted above and it will also give the client the correct impression that they are important.

▪ Are the Methods Appropriate to Attain the Objectives?

The current strategies fail to address the issue of how to assist our students to find a suitable client, which is vital to the success of the project. Besides, the specific guidelines are more beneficial for students who attempt to work on systems development project, but do not address each stage of systems development in detail.

- Early Orientation Sessions on How to Select a Client and Problem are Critical
  Students are generally overjoyed when finding a client, but without further investigation, they are unaware that this may not be the best client for them. If an early orientation on how to select a client and how to identify a problem is arranged, possibly one or two months before the semester starts, then this may help students avoid difficulties.
- List of Methodologies Used in Systems Development
  The supervisor should provide students with a list of methods typically used in each stage of systems development. This allows students to compare different available methodologies, and to select one which is appropriate for their project.

▪ Are the Assessment Procedures Appropriate to Measuring the Objectives?

In the previous subject outline, the assessment criteria for all the written assessments components were not listed. The following approach is an improvement based on the '3Cs' approach to clarifying marking criteria.

- Content (50%)
  This covers the quality, the appropriateness and the coverage of the materials selected.
- Construction (20%)
  This covers the proper use of grammar, formatting, referencing and structure to present the materials.
- Composition (30%)
  This covers the student's ability to justify, analyze and present the necessary argument.

▪ Is There an Obvious Link Between the Four Curriculum Elements?

By making the above adjustments, there is now an obvious connection between the four curriculum elements:-

- Stating Objectives
  The new aim and objectives in this subject will serve as a good indicator as to how students should approach the project since justification of what they are doing is now highlighted.
- Selecting Learning Experiences
  By comparing different systems development methodologies, students can evaluate each method and select the one which is most appropriate for their project.
- Organizing Learning Experiences
  The specific guidelines serve as a step-by-step approach enabling students to organize their learning experiences.
- Evaluation
  In addition to the requirements in the specific guidelines, the 3Cs approach clarify the main criteria in the marking of all the written assessments.

Conclusion

This paper describes how a BIS Department offers a 'real life' case study project to facilitate student learning. It also discusses various problems encountered by project supervisors in monitoring this project. Except for resource limitations, the other problems relate to the characteristics of the client, the standard and background of the student, the nature of the project selected and the divergence of values and expectations among the different parties involved in the project.

In attempt to illustrate and overcome these problems, several of the recent modifications made to this subject are presented. These changes were based on an application of Tyler's Objectives Model and resulted in: clearer aims and objectives; the inclusion of content appropriate to the revised objectives; the introduction of different methods of presentation to ensure changes are accomplished; more precise and appropriate assessment criteria and an integration of objectives, learning experiences and evaluation.

The final outcome of these changes is an attempt to focus the student, client and supervisor on a common set of objectives, outcomes and expectations which contrasts to the usually divergent expectations among these three participants in project oriented subjects.

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A Model for the Computer Literacy Course

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ABSTRACT

This paper describes a proposed model for the computer literacy course in the information systems curriculum. The model suggests that the specific content of the course is not as important as the type of experience provided for the student. A successful experience of learning to use the university's computing environment over a four year period is an excellent preparation for functioning in a future business computing environment. The software tools will change in a short time, but the experience of learning to adapt to a computing environment will be an useful skill for a career.

INTRODUCTION

The first information systems course offered to undergraduate business students varies from university to university. These courses could be labeled as literacy courses, introduction to information systems courses, or the combination of literacy and information systems topics. This paper addresses the literacy course approach as well as a suggested approach to this first year course in the business curriculum.

The topics vary in the literacy course and there is "no consensus as to the nature of computer education for business students."[1] Topics are centered around computer programming, business application packages, or information systems concepts.[2] One common approach to offering the literacy course is to present detailed training for selected software application packages through hands on use and realistic business problems. The motivating factor for presenting this training is to provide the business student with the knowledge and skills for future courses in the curriculum.[3] There is also intense debate over which software packages should be covered and the amount of training needed for each package.

MODEL FOR LITERACY COURSE

This paper proposes a model for the literacy course to be offered to the first year business student. The mission of the course should be to introduce the student to the computing environment of the university and provide successful experiences in using computer resources. Notice that this mission will vary by definition from university to university. The model is based on the assumption that the university is attempting to maintain and develop an information system that supports the university's needs. Some universities will be on the cutting edge of technology and others will not, which is also true in the business environment. If the literacy course provides the student with successful experiences using the computing environment at their university, then the student is prepared to work in this environment for four years. Even though the student may not have detailed knowledge of every component of the university computing environment, the course will provide the background and confidence to extend that knowledge when taking other courses in the business curriculum. We should not consider the literacy course as an end in itself, but should think of it as the initial step in learning about the computing environment, a process which will continue for four years at the university. It is also important for the business faculty to consider part of their class work as an extension of this literacy course. Such a policy will enable the students to use the computing environment as part of their coursework.

The model by design does not suggest specific software packages and does not assume any specific number of hours for credit. The software packages and topics match the specific environment of the university. The number of hours is dependent upon the needs of the business school and the background of the students. We have been successful in implementing this model in the time equivalent of a one semester hour course.

TEACHING APPROACH

1. Mode of Presentation. The suggested method of presentation is the use of a teaching laboratory environment where the instructor has a projection system connected to a computer In addition, each student has a their own workstation. The laboratory session can typically be presented in a 60-75 minute period. The instructor leads a group of 15-20 students through a planned activity which would be similar to the homework assignment for that week. Students observe and emulate the instructors example projected on the screen in the front of the room.

2. Personnel. It is suggested that one senior faculty be responsible for coordinating the course and writing the lab or instructional scripts. Junior faculty and/or graduate teaching assistants should make up the bulk of the teaching staff.

We have been successful in using one senior faculty member and teaching graduate assistants. Weekly staff meetings are used to review the topic for the next week. Novice staff members also observe the senior member teach each topic before they teach the topic in their sessions.

3. Scripts. To maintain a uniform presentation for all students in the course, it is recommended that the senior faculty member create scripts for each laboratory session. These instructions document the important topics for each session. The scripts lead the student through features of the software being covered for the session. The scripts do not attempt to cover too many features, because this only leads to confusion for the student. The scripts are similar to the homework assignments which provides a successful experience using the features needed to complete the homework.

4. Help sessions. Our policy is that instructors schedule time periods in the laboratory when they are available to answer questions related to the homework. The instructor is careful not to do all the work for the students. It is desirable for the students to develop their own problem-solving skills in order for them to successfully complete the homework assignments. We have had some abuse of the instructor's time at the help sessions by students. These pupils did not attend regular class and expected the instructors to repeat the class activity. When helping students, the instructors emphasize the importance of taking notes in the help sessions. Students learn the importance of taking notes when they attempt to do their homework.

OUTLINE OF LABORATORY SESSIONS

Each university has their own unique computing environment and may differ significantly from the outline provided below. The point is that it is not important what software is being taught or what specific topic is discussed, but it is important that you provide a successful learning experience which introduces the student to the university's computing environment. To illustrate the implementation of the proposed model, the following topics are being taught at our university:

1. **Using Communication Software and Email.** We provide an introduction to using a communication control program which places the computers in our lab in a terminal emulation mode. We cover the use of the university's email system. Another topic covered is file transfer, since some students live in the university's dorms and need access to assignment files which are stored on a different computer. We find the email assignments an excellent ice breaker for getting the novice user started.

2. **Introduction to DOS.** Although the computing environment with PCs is moving to the Windows platform, we still spend one lab session on the DOS operating system. Teaching DOS provides the fundamental background of the IBM PC operating system and also prepares the student for the Windows session of the following week.

3. **Introduction to Windows.** The Windows lab session introduces the students to the Windows graphic user interface. The students are introduced to general Windows functions and principals. The File Manager is used to replicate many of the DOS commands covered in the previous session. Many students have to develop the skills in using a mouse.

4. **Introduction to Wordprocessing.** Since wordprocessing is considered to be the most common computer experience for incoming college students, only one session is devoted to the topic. Basic editing skills are covered to provide the necessary skills for document preparation in future classes.

5. **Internet and Library System.** The Internet and library system session builds on the first session where they learned to use the communications control program. Students are taught to interface with the university's on-line library system where they research several topics. The second part of the session provides instruction on the use of the Internet. Students are given an assignment which requires use of the on-line library system, the internet, email and wordprocessing.

6. **Introduction to Spreadsheets.** The coverage of spreadsheets is divided into three sessions. The introduction session covers the general design of the worksheet, construction of a simple worksheet and the use of simple formulas.

7. **Using Spreadsheets.** The second session on spreadsheets covers the construction of more complex worksheets. The major portion of the session is built around the concepts of absolute and relative references, copying

formulas, and preparing the output so that it has a professional appearance.

8. Business Graphics. The third session on spreadsheets covers the preparation of business graphics. The session covers the terminology and techniques of preparing graphs on the worksheet. Students use worksheets prepared from previous assignments as the source data for the graphs assignments.

9. Introduction to Database Applications. In the first database applications session, the students are taught to use a database management system. Students construct the structure of the database and input database records.

10. Generating Reports for Databases. The second database session is based on the preparation of professional appearing reports. The database used was constructed in the previous sessions. This lesson also covers how to prepare and print mailing labels.

11. Using a Statistical Package. All business students at our university are required to take a statistics course where they make use of a commercial statistics package. We introduce the students to this statistics package. The content of the session is designed around the process of preparing a statistical program and alternative methods of building a data set. Since this is not a statistics course, we provide an assignment which solves a very simple statistical problem. The idea here is to familiarize the student with the basic functions of interacting with the software. Seeing statistical output in this session gives the student a familiar base to refer to in future statistics classes.

12. Using Communication Software and File Transfer. The final session attempts to tie together the different sessions covered during the semester. The students are asked to transfer a file using FTP from a file server to their PC. The file which was transferred is then loaded into the spreadsheet software where the file is modified. A copy of the spreadsheet is then inserted into a memo prepared using the wordprocessor. This document is then saved as an ASCII file and then transferred back to the file server. The transferred file is then sent to the instructor using the email program. Although this session involves many steps, the students seem to enjoy the exercise because it provides closure from the previous sessions and gives them a sense of applying accumulated knowledge. Confidence in their ability to use computers is put to the test.

EVALUATION OF STUDENTS

Evaluation of students in literacy courses can be difficult. Testing in a classroom environment is limited to a fixed time frame. The skills taught and the problem solving part of the course will take more time for some students compared to others. We have selected two types of evaluation: (1) homework assignments and (2) in class exams.

1. Homework Assignments. Homework assignments are closely aligned to the laboratory activities. Laboratory sessions are designed to develop specific skills using a component in the university's computing environment. The assignment is designed with the expectation that the student will use and apply these skills to solve a business problem. Since this process may take longer for some students, the assignment is given as an out of class activity. We are aware that this approach provides for the opportunity of plagiarism. We attempt to monitor this problem, but it is difficult to catch cheating. We hope that the second type of evaluation will help distinguish those students who do not submit original work.

2. Exams. Exams throughout the semester provide a check and balance on the students' work. Most of the questions can be based on the technical skills taught in the labs. Some questions ask the students to apply what they have learned to solve specific problems. The combination of homework and exams provides a fair assessment of the students work.

SUMMARY

This paper addresses a model for the first year computer literacy course. Instead of addressing the details of what software should be covered and what skills are important to prospective employers, the model suggests the students should be taught to use the existing computing environment of the university. Learning to function in this environment as first year students is the primary objective of the literacy course. The computer literacy education of the students is not complete with this single course. Students must continue functioning in this environment throughout the four years at the university. Advanced courses will demand that they use and expand the skills taught in the first year course. It will continue to be common that versions of software will change and that students will have to adapt. They may have to change from the DOS software that they were taught in the first year course to a Windows version that has replaced it. We believe that students who receive this type of literacy training will be more successful when employed by a company. As new employees, they will be able to adapt to the new computing environment of the company in a smooth transition. Students will be more successful than if they had detailed training in specific software packages.

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Introduction to Programming With Visual Basic

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Abstract

Introduction to programming has taken on many formats over the years with different objectives, languages, and content. Typical languages used have included Basic, COBOL, and Pascal. Content varies from focusing on program structure using various tools such as pseudo code, flow charts, and decision tables, to focusing on problem solving scenarios for the typical basic applications in business systems. Most introductory courses cover language basics, program control structures, logical and arithmetic operators, and data handling. Windows, and the concepts related to working with objects, add more dimensions to our curriculum coverage. We have decided to introduce some of these concepts into the introduction to programming using Visual Basic. This paper a) details the various concepts we are trying to cover, b) shows some of the projects used to introduce these concepts to the student, and c) summarizes limitations and some of the challenges associated with introducing these concepts at the introductory level.

Introduction

CIS curriculums have used many approaches over the years to introduce programming to students in the CIS program The approaches have included 1) an introduction to programming logic using pseudo code and flow charting, 2) an introduction to programming using Pascal or Basic, 3) an introduction with a survey of languages, or 4) an introduction to COBOL. Part of the variation is due to the orientation of the program, and some variation is due to the number of credit hours available in the program. Our curriculum has traditionally been targeted toward entry level programmer analysts with a heavy technical emphasis. The introductory course has used BASIC for a number of years to teach the introductory concepts of programming, before going into two semesters of COBOL. We decided to change to Visual Basic this year to introduce the student to GUI design for windows, event driven programming, and to object oriented concepts. This is an addition to the other concepts that we normally try to cover in an introductory programming course. This paper discusses the content of that course and some of the difficulties in using Visual Basic in an introductory course.

Traditional Course Content

The traditional content of the introductory course has normally included the following concepts.

1. Data representation, types and size (Binary, ASCII, EBCDIC, BCD, integer, floating).
2. Data storage (Bytes, fields, records, files, indexes)
3. Data names.
4. Data input (files, records, formats, data entry, data validation).
5. Data output (files, records, reports, formats).
6. Program structure (Sequence, Iteration, If-Then, Case, Subroutines).
7. Logical and arithmetic operators and structures.
8. Program construction, editing, compiling, testing, debugging, documentation.
9. Table definitions and the use of subscripts.
10. Problem solving scenarios a) File to report b) Control Break logic c) Table processing with table lookup d) Direct and sequential file processing e) sorting data f) user interface design including menus and screen interfaces.

Adding Visual Basic to this course adds another set of concepts that includes the following:

1. Window controls and their behaviors: a) Menu bars, scroll bars, status bars, b) Command buttons, radio buttons, check boxes, c) Dialog and message boxes, d) List boxes, e) Standard window behaviors, f) GUI text (fonts, point sizes, and characteristics).
2. Event driven program structure.

3. Graphics: a) objects (bitmaps, icons), b) drawing graphical objects.
4. Windows, GUI environment, multitasking, multiple windows.
5. Object orientation with properties, methods, and associated events.

Project Descriptions and Related Objectives

The course was taught using a handbook for Visual Basic because there was very limited text material to teach the course. The text selected was "The Visual Basic 3 for Windows Handbook" by Gary Cornell. The following projects were developed to teach as many concepts as possible integrating GUI, object orientation, and the traditional topics in programming.

Project 1 Visual Basic Environment I

Objective: To explore the Visual Basic environment, including:

- Forms and form properties
- Event procedures
- Print Method
- End Method
- Text formatting
- Use of a Push Button

Short Description: The project requires the student to create a window with the following features: a) Display a caption 'Project 1' with specified size, location, and color properties, b) display a push button 'STOP' with specified properties, c) setup an event associated with the form being clicked once that will change the size of the window, d) setup another event associated with the form being clicked twice that will print a message with specified properties using 'print method. and e) setup an event to terminate execution using 'end method when the stop button is clicked.

Project 2 Visual Basic Environment II

Objective: To begin programming in the Visual Basic environment, including:

- Multiple forms and form properties
- Event procedures
- Use of a text box, command button, label, and frame controls
- Runtime changes of control properties
- End method
- Text formatting and numeric conversion using FORMAT$
- Show and Hide methods for a form
- Val function for text to numeric conversions
- String concatenation operator
- Dim statement for declaring variables
- Multiply operator for numeric variables

Short Description: The program consists of three forms: Main Menu, Date Entry Form, and Product Entry Form. When the user selects the Date Entry Form, the focus should be on the month text entry box. After the user enters the Month, Day, and Year, the Show Date button is clicked which causes the date to appear in the frame labeled 'Entered Date' as mm/dd/yy.. Clicking the Main Menu Button causes the Date Entry Form to close and the Main Menu window to receive the focus. If the user selects the Product Entry Form, focus should be on the quantity text entry box. After the user enters the quantity and price, the Calculate Tax button is clicked which shows the calculated tax at six percent and the total of quantity times price plus tax. Clicking the Main Menu button causes the Product Entry Form to close and Main Menu window to receive the focus.

Program Sample:

The "Product Entry Form" window for project 2 is shown in figure 2. Quantity and Price are entry fields to be filled in by the user. When the Calculate Tax button is clicked, the Calculated Amounts labels are computed and filled.

The following event logic for the Calculate Tax button shows:

- Dim statement for variable declaration (all variables must be declared before use in all assignments)
- Conversion of string variable to numeric
- String concatenation with the "+" operator
- Conversion of numeric to string with specific formatting applied
- Arithmetic expressions supplied as arguments to functions

```
Sub cmdCalculateTax_Click ()
  Dim Temp As Single
' Calculate extended total
  Temp = Val(txtQuantity.Text) * Val(txtPrice)
' Fill Tax Caption
  lblTax.Caption = lblTax.Caption + Format$(Temp * .06,
"CURRENCY")
' Fill Total Caption
  lblTotal.Caption = lblTotal.Caption + Format$(Temp *
        1.06, "CURRENCY")
End Sub
```

Project 3 Sequential File Processing and Reports

Objective: To produce a product report, count the number of records, and calculate the dollar amount of all products using:

- Do-While loop construct
- Relational operators
- Counter variables
- Total variables
- Text formatting
- IF-Then-Else construct
- End-of-file processing
- Message box
- File Open statement
- File Close statement
- Processing records in a sequential file

Short Description: Create a program that reads a sequential file containing a product number, product name, product quantity, and price. Display a formatted report that contains a heading, detail lines for each record in the file, the total count of all products, the totals of each product category, and the total value of all products. Use the MsgBox statement to display a message indicating that the report has been completed. The program will consist of a main window with a push button menu: Report Generation and Exit. When Report Generation is clicked, the report is generated in a separate window. After the report finishes printing, the message box is displayed with a OK button. When the user clicks the OK button on the message box the report window should close and the main window should have the focus.

Program Sample:

Figure 1 shows the report window that is generated from running Project 3. When this window gets focus the report is created using the overall logic shown in the GotFocus event for the form.

The GotFocus event logic below shows:

- Calls to lower level procedures to perform specific work
- Do-While loop
- Sequential End-Of-File processing
- File input statements
- Order and division of report generation logic

```
Sub Form_GotFocus ()
  'print header
  PrintHeading
  'process file records
  Input #1, ProductCode, ProductDesc, Quantity, Price
  Do While Not EOF(1)
    CalcTotals
    Input #1, ProductCode, ProductDesc, Quantity, Price
  Loop
  'print totals
  PrintTotals
End Sub
```

Project 4 Arrays, files and sort

Objective: To load an array from file data, sort the array and display the array contents on a window using the following:

- Dimensioning array variables
- Loading array variables
- Bubble sort of array elements
- Using flags and switch variables
- Use of a menu bar
- Enabling and disabling menu items
- Use of a control array
- File processing and other constructs used in project 3

Short Description: The program reads a sequential file of names into an array. The program has one window containing a menu and an empty label control array where the array name may be displayed. The main menu item consists of the dropdown items 'Load', 'Sort', 'Display', and 'Exit'. The menu items 'Sort' and 'Display' should be disabled until the array values are loaded from the file. The window also contains the label 'Names appear in the array to the right' and 'Names are Sorted' or 'Names are not Sorted' to show the status of the names in the array.

Program Sample:

Figure 3 shows the form used in Project 4. The names in the array are populated by reading from a sequential file, but the names are unsorted in the array when read. Dropdown menu items under Array include Load- to load the array from a file, Sort-to sort the names, and Display- which displays the names either sorted or unsorted.

The following event logic for the menu item Display shows:

- Use of flag or switch variable for display of sorted message
- For-Next control construct
- Concept of control arrays in Visual Basic
- If-Then-Else-EndIf decision logic

```
Sub mnuDisplay_Click ()
Dim Index As Integer
  For Index = 1 To NumberInArray
    lblArray(Index - 1).Caption = Names(Index)
```

```
      Next Index
      If SortedFlag = 1 Then
         lblSorted.Caption = "Names are sorted"
      Else
         lblSorted.Caption = "Names are not sorted"
      End If
   End Sub
```

Project 5 Dimensional Arrays with Grid Control

Objective: To explore two dimensional arrays using the Grid Control and to learn how to put error trapping in a program.

- Two dimensional arrays
- Grid control
- Loading grid cells
- Creating additional procedures
- Use of select case structure
- Using error trapping with on error

Short Description: Create a program that reads a sequential file containing 12 months of expense data on Utilities, Payroll, Office, and Rent expense. The program will support a menu for 'Load Data', 'Calculate', and 'Exit'. 'Load Data' will read the data from the file, loading the data into the Grid. Error trapping will be used to check for errors '71 - Disk not ready' and '53 - Unable to locate input file'. 'Calculate' will total the rows to get row totals, total the columns to get column totals, obtain a grand total, and place all totals in the grid. 'Exit' will terminate the program. The program also supports adding a graphic to the window with the 'Add Graphic' button. The graphic selected depends on the selection entered in one of three option buttons in a graphic options group on the window. Each Icon is loaded with the 'Loadpicture' statement. A print button is used to print the form on the printer using the PrintForm method.

Project 6 Working with Controls

Objective: To develop a program that uses various controls on a window including the following.

- Drop-down list box
- Shape control
- Check box control
- Option button control
- Frame control
- Multi-Line, font Size, and Scroll Bars
- Name controls
- Copy controls
- Use of Additem to add items to a list box

Short Description: This project starts by building an application with additional controls and multiple events. The window allows the user to select a movie, use a check box to apply a discount, use option buttons to select number of tickets purchased, show the total amount, and record the transaction in another drop-down list.

A summary of the various concepts covered in the course by project is shown in figure 4.

Summary of Experiences

The nature of the changes from a traditional introduction to programming to a Visual Basic introduction to programming are substantial. Approximately half the content of the course must change to include new topics. An event driven programming model and object orientation creates new challenges for the professor to enable students to visualize and understand the program logic, and generally there is a lack of text book type publications with ancillary materials to help in the transition.

As topics, including Windows concepts, graphical user interface, and event driven program structure are added to the traditional course content, something has to give. About one third of the class time was devoted to these new topics. In order to accommodate these new topics, time usually devoted to different search algorithms, random file processing, random file indexing, and internal functions for handling string and data manipulation where deleted from the course content. Adding some of the new concepts is not as easy as it may appear.

To help the students develop an understanding of Windows at a programming level it is necessary to differentiate between what Windows does and what Visual Basic does. Diagrams explaining the Windows messaging system and how Visual Basic operates were helpful in making this distinction. However, if the professor has not previously programmed in Windows using another language like C or C++, some of these lower level Window concepts may be illusive.

Event driven programming is wonderful, and when combined with the Visual Basic Toolset, it provides easy access to event logic by the programmer. Unlike traditional sequential programming logic, the event model with Visual Basic includes both a pure event model along with sequential code modules. A great difficulty arises in getting the student to visualize the entire program structure and to understand what portion of the code is executed at what time. An object hierarchy is used with lower level calls to sequential routines to explain the structure. Students have little difficulty understanding the objects and associated properties, events, and methods. However, understanding the possible scenarios of execution under the event model was hit and miss. Several programs where created for class demonstration that showed the sequence of events and messages that Visual Basic was processing. These programs gave the students a visual picture of how Visual Basic was receiving and processing events.

At the time this course was started the majority of text material consisted of trade publications. About eight different trade publications were reviewed and were found to be in the following categories: Quick Dunk - aimed at the already experienced programmer that is just relearning a new language, Reference Manual Regurgitation - these where just reformatted, or reformatted with some annotation of existing Microsoft reference manuals and, Visual Basic Guru - all the tricks and wonders that an experienced Visual Basic programmer might want. There was a general lack of complete problem development, thorough coverage of foundation concepts, and student projects to support the course. As new text books become available, this problem will ease. Currently, the course text, projects, tests, and overheads should be a significant consideration when moving to a Visual Basic course.

References

Available upon Request

Figures

Figure 1 Inventory Report From Project 3.

Inventory Report

Inventory Report04/15/95

Product Number	Description	Quantity	Unit Price	Extended Price
100	Chair	3	230.40	691.20
110	Table	2	256.90	513.80
120	Desk	1	783.00	783.00
130	File Cabinet	2	134.22	268.44
140	Lamp	3	48.20	144.60
200	Fax Mach	1	376.44	376.44
210	Computer	2	2245.60	4491.20
220	Scanner	1	1380.77	1380.77
230	Monitor	2	657.33	1314.66

		Office Fixtures		$2,401.04
		Computer Equipment		$7,563.07
				=====
		Grand Total		$9,964.11
		Number of Products		9

Figure 2 Product Entry Form used in Project 2.

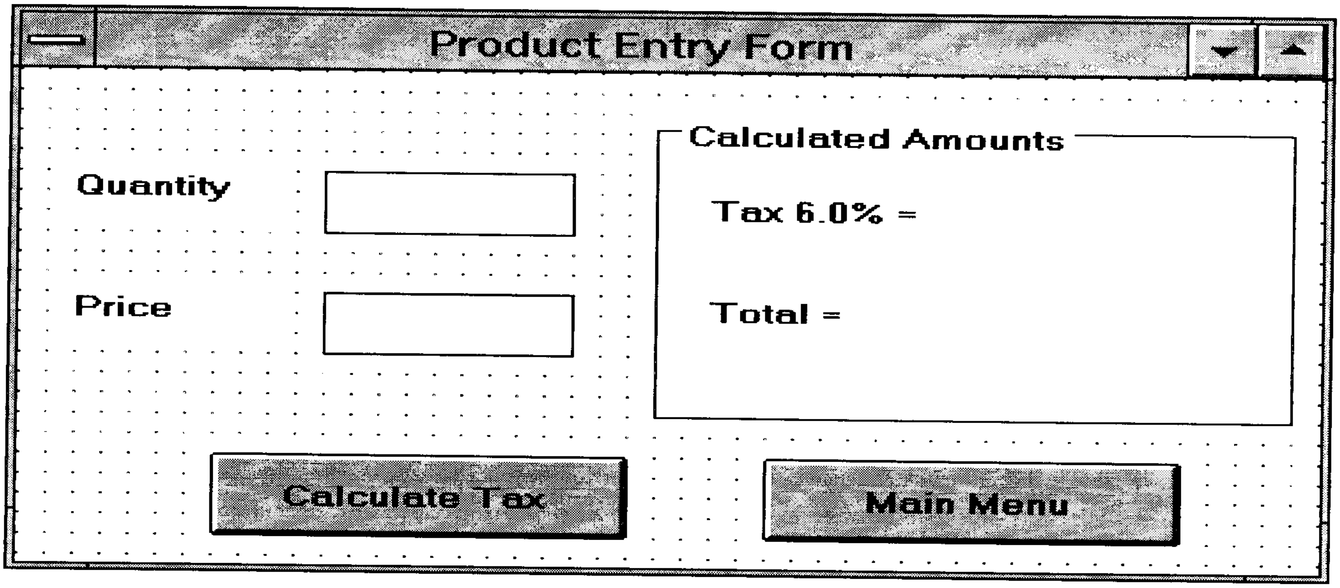

Figure 3 Array Processing Form used in Project 4.

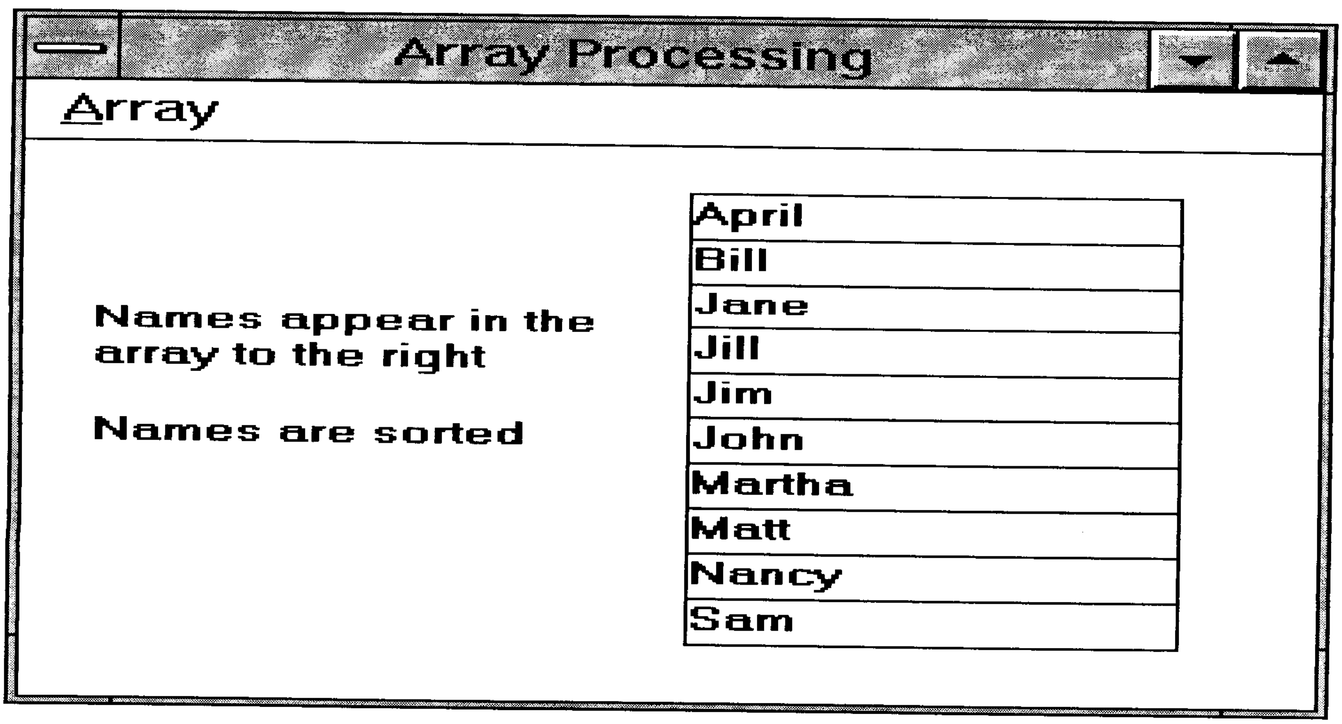

Figure 4 Summary of Concepts Covered

Concept X = Concept introduced or expanded	PROJECTS 1	2	3	4	5	6
DATA						
Data Representation (Binary, ASCII, EBCDIC, BCD, Integer, floating)		X	X			
Data Storage(Bytes, fields, records, files		X	X			
Data Names	X	X	X	X	X	X
Data Input (files, records, formats, data entry)	X	X	X	X	X	X
Data Output (files, records, formats)			X			
Text/Numeric conversion, String functions		X	X	X		
PROGRAM DESIGN						
Program structure (Sequence, Iteration, If-Then, Case, Subroutines)		X	X			
Logical and arithmetic operators and structures		X	X			
Dim statement for declaring variables		X				
Do while loops			X	X		
Counter and total variables			X	X		
Flag and switch variables				X		
Processing records in a Sequential File Open, Close, EOF			X	X	X	X
Table definitions and the use of subscripts				X		
Program Construction, editing, compiling, testing, documenting		X				
PROBLEM SOLVING Scenarios						
File to report			X			
Control break logic			X			
Table processing and table lookup				X	X	
Direct file processing						
Sorting and displaying data on a window					X	
Sorting Data				X		
WINDOWS AND GUI						
Windows, GUI environment, multi-tasking	X	X				
Object properties, methods, events	X	X				
GUI (fonts, point size, twips, characteristics)			X	X		
Graphic objects (bitmaps, icons)					X	
Event driven structures	X	X	X	X	X	X
VISUAL BASIC OBJECTS AND EVENTS						
Forms and form properties	X	X				
Use of a pushbutton	X	X				
Text formatting	X					
Print method	X					X
End method		X				
Multiple forms		X	X	X		
Command button, label, and frame controls		X			X	
Runtime changes of control properties		X			X	X

Message box			X	X		
Menu bar				X	X	
Enabling and Disabling menu items				X	X	
Drop-down list box						X
Shape Control			X			X
Check Box					X	X
Option Button						X
Variable and Control Naming Standards	X	X	X	X	X	X
Multi-line, Scroll Bar properties for text boxes						X
Grid Control					X	
Graphic drawing						

A Framework For Information Systems Programs And Business Relationships

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ABSTRACT

As competitive and technology challenges face U.S. businesses in the late twentieth century, educators are reassessing their information systems (I/S) programs. This paper focuses on the importance of corporate involvement in that reassessment process. The paper presents several examples of university-business partnerships. Strategies are provided for developing the corporate relationships necessary to drive I/S education into the next century.

KEYWORDS: Information Systems, I/S and Business Relationships, Adult Education

INTRODUCTION

To remain competitive globally, the U.S. must assess past business strategies and seek "best practice" goals to meet the competitive challenges ahead. If these challenges are going to be met, the academic community must play a significant role in recognizing and supporting industry changes. Due to the importance of information technology in today's business environment, information systems (I/S) programs and the business community must work closely to accomplish these goals.

Since I/S is an applied discipline, close associations among faculty, industry leaders, and students are crucial to provide the integration of theory and practice deemed optimal for I/S programs. Open communication among academic and corporate-based faculty, as well as industry experts, is necessary to stay abreast of the ever increasing knowledge base in the I/S field. The flow of knowledge back to the corporations provide opportunities for business innovations as well.

There has been much discussion about the need and value of close ties between industry and academia in the development and implementation of I/S programs and yet few institutions actually have them (Jackson, 1991; Longenecker and Feinstein, 1991). Large numbers of U.S. companies believe that existing I/S programs "are not preparing their graduates for the reality of the business world" (Wiersba, 1992, pp. 51). This paper presents a framework for assessing potential partnership arrangements between universities and businesses. Three examples of strategies for partnership relationships are provided also.

BACKGROUND

Industry Perspective

The number of information systems jobs is forecast to grow substantially in the 1990s. Of the 50 fastest growing U. S. jobs for the period 1988-2000, 7 were in information systems (U.S. Dept. of Labor, 1990). More importantly, I/S jobs accounted for 21 percent of the projected numerical growth, totaling 1.2 million new jobs. Although the demand for technology-related jobs is rising rapidly, meeting that demand may be difficult. The Office of Technology Assessment (1990) indicates that 20 to 30 percent of U.S. workers lack the skills necessary to implement new technology effectively. Providing these workers with the necessary technology skills as well as re-educating those workers making career shifts toward technology fields necessitate closer industry-academia ties than ever before. Business is now looking to academia to aid in the re-skilling of current employees, not just the education of future employees.

Industry plays a vital role in this educational process. First, industry leaders and experts are often a vital source of information to allow academia to keep abreast of these technology-based transformations. In the I/S field, where technology changes occur at ever increasing rates, having access to sources at the forefront of these developments is quite advantageous. Second, industry remains the primary employer for I/S graduates. Industry executives are in an excellent position to see the strengths and weaknesses of various programs. Their advice should not be taken lightly. Many executives are thinking not only of their immediate labor force but also what employee skill sets are necessary to meet the challenges of the twenty-first century. Third, industry is becoming increasingly a major source of students for academic institutions. Given the population shifts toward multiple careers, the focus on continual or lifelong learning (Applegate et al., 1993), and the increasing economic pressures to acquire an education while employed, corporations are critical players in academia. They not only hire many university graduates, they now supply and fund increasing numbers of university students.

In summary, the U.S. workforce has shifted in composition and structure. Likewise, U.S. business faces greater competitive forces globally than ever before. Businesses are recognizing their need to change the way they do business and look to other partners for support in addressing these changes. Likewise, these changes can be viewed by educators in two ways: 1) they can continue to "do business as usual" at the risk of their long term survival or 2) they can view these changes as opportunities to totally reassess "the way that *they* do business" also.

The Role of Academia

There are a plethora of changes occurring in I/S programs all over the country. Wiersba (1992) speaks of the new breed of I/S professional. This professional is one with an emphasis and expertise in evaluating the direct business impacts of information systems rather than focusing on technical implementation. The skills necessary for this shift are broader, communication-based, and require an entrepreneurial perspective.

Allowing input from each group of stakeholders is necessary to achieve the quality and focus of a program that addresses both the conceptual underpinnings and the practical emphasis desired. Academic I/S departments can respond by taking a proactive stance to provide new program designs, curricula, and academic-corporate links to satisfy the variety of stakeholders involved in this process.

This input and interaction between the corporate and academic players can be achieved in a multitude of ways:

- Creating I/S curriculum committees with corporate partners for curriculum development.
- Developing corporate advisory committees for on-going program assessment and specialized issues.
- Sponsoring I/S course partnerships which include guest speakers, corporate-based adjunct faculty and academic-corporate team teaching.
- Requiring project courses which involve oversight by industry contacts.
- Encouraging and facilitating student internships at local companies.
- Academic and business knowledge sharing though joint research/industry projects.
- Organizing technology workshops or seminars of mutual interests.

We believe that the best strategy is to have corporate and academic interactions from several sources. This reduces the likelihood of industry input being uneven and anecdotal (Crockett, Hall & Jeffries, 1993). Long term success in I/S education requires as accurate a perspective as possible. This means approaching with a fresh look what is required for a quality I/S program. Incorporating the input of faculty, students and industry leaders is a key element in this process. Each stakeholder group has a unique and valuable perspective for designing and maintaining a program that integrates both theory and practice.

The most important aspect of this strategy is the commitment to a re-engineering perspective. Program development must be undertaken, not with an attitude of minor adjustments to an existing program, but with a fresh look at what is required for a quality I/S program.

FRAMEWORK

In examining the possible strategies for I/S - business partnerships, it is beneficial to present a framework for discussion. The framework presented here represents only one of several possible methods for discussing these issues. The authors present this partnership grid concept as one possible strategy for determining optimal partnership arrangements between individual universities and corporations.

The framework presented focuses on the relationship between required resources and the comprehensiveness of the partnership activities desired. Resources refer to the financial and human resources needed to support the partnership. Comprehensiveness refers to the depth and/or breath of the partnership activities that form the basis of the relationship. Typical partnership activities include research and knowledge exchange, consulting, project planning, involvement in curriculum development, training, and workshops or seminars. The scope and depth of the partnership activities are determined partly on the resources required to fund and maintain them and the specific needs of the partners involved.

The concept of the partnership grid is as an exchange mechanism between industry and academia. Since the problem of scarcity is always prevalent, (not all options are available to all participants), the goal is optimization. Optimization is determining the best combination of goods or services for the resources available to the participants. The goal is to work toward a pareto optimal allocation of goods/services where no further exchange of goods is possible without leaving one of the parties worse off (Hirshleifer, 1980). Economic theory suggests that the system is then balanced and in equilibrium. The costs of these trades in the partnership grid are a function of the number of activities and timeframe involved.

These exchanges are both economic and the exchange of ideas. Economic exchanges consist of funds and/or personnel. Funds from corporations to universities may take the form of grants, internships, free professional time for the institution, curriculum development, etc. as well as tuition support for students. Funds from universities to corporations may consist of free or discounted business training and/or corporate research. Personnel resources range from corporate-based university faculty, faculty internships or consulting arrangements, student internships and university graduates as corporate employees.

In addition to economic exchanges, idea exchanges are important benefits in university/corporate relationships. The flow of ideas from corporations to universities range from curricular ideas by steering committee members to research collaboration. The flow of ideas from academia to business may consist of industry workshops, university graduates who become corporate employees, and/or research results. Obviously, in these exchanges, the flow of ideas is less constrained by the economic arrangements defined by the partners.

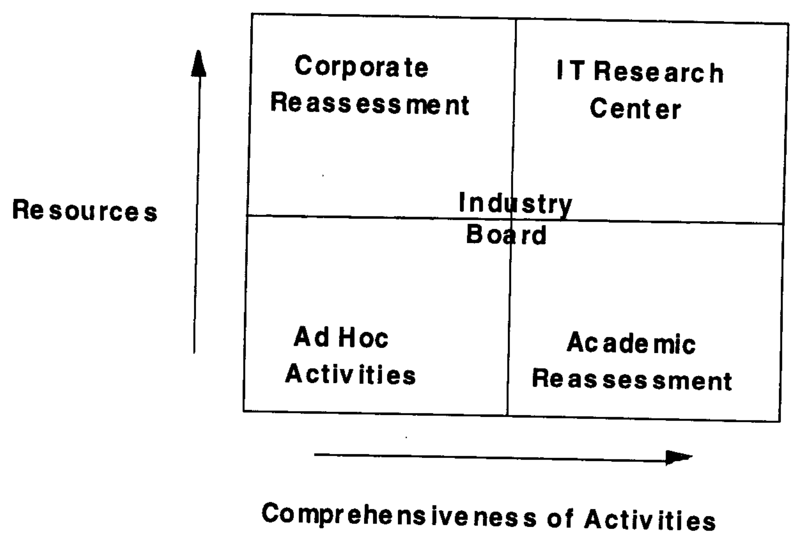
The academic/corporate partnership grid provides a vehicle for assessing optimal relationships between academic and corporate organizations within these parameters. Locations on the grid indicate some typical academic/corporate partnership arrangements found currently. The grid provides a useful tool for both academic institutions and businesses to assess their current relationship or to start discussions concerning what form their partnership should take. For example, when resources are plentiful and the scope and/or depth of the partnership activities is large, the academic and corporate partners may want to consider investing in an IT research center. Such a center could provide the administrative and continuity components for ongoing corporate IT workshops, funded research, and formal points for information exchange. The continuity of a center allows for varying degrees of individual member involvement on both sides of the partnership without major disruptions in the relationship itself.

At the other end of the grid, those academic/corporate relationships with limited resources may elect to follow a more ad hoc agenda, concentrating on specific needs and projects. These relationships are usually more tied to the involvement of individual players in the relationship. Without a more formal organizational structure to maintain the relationship, activities with specific beginning and ending points and/or those activities with little maintenance are more likely to succeed. Likewise, a position of medium resources and partnership activity needs might result in an industry board where corporate members advise on I/S curricula issues, provide research funding, and engage in the exchange of ideas.

The academic/corporate partnership grid allows the partners to see where reassessment of the relationship might be warranted. In situations where the comprehensiveness of activities desired is great, but the resources available are minimal, the academic partner may want to assess the feasibility of embarking on a series of workshops, ongoing training, research, etc. A solution to possible overcommittment may be to commit to fewer activities or conduct the activities over a longer timeframe. Likewise, if the corporate partner determines that a large resource base has resulted in minimal depth or scope of activities, an assessment of effective resource use may also be conducted.

The grid is presented below:

Figure 1.
Academic/Corporate Partnership Grid



One mitigating effect to the partnership grid presented above concerns the surrounding environment. The interactions between the business organization and the academic organization will be influenced by the type of metropolitan arena in which the parties find themselves. These environments range from rural "low-tech" towns to very "high-tech" metropolises, with everything in-between. Partnership activities needed and/or possible will be influenced by this surrounding environment.

Since large IT research centers require vast resources, they may not be possible in areas where there are few business organizations to help fund them. A few medium to small businesses will rarely have the resources to support a large IT research center. Additionally, they may not have the need for cutting edge IT research, but prefer a series of workshops or seminars conducted in conjunction with the local university
This paper now presents three scenarios that exemplify the use of the partnership grid to

examine academic-corporate relationships. These hypothetical situations represent the process that universities can use to assess their current and future directions with corporate partners.

Scenario 1 (U of A)

This small private university is located in a major metropolitan area of approximately 10 million people. U of A has a large undergraduate I/S program for non-traditional students. The students generally possess five to ten years of industry experience before entering this program. Due to the geographic area that U of A services, the university has one main campus and four regional campuses. Having students with business experience, U of A has both full-time and adjunct faculty with extensive practical experience. They provide continual training to strengthen the academic and teaching skills of the corporate-based faculty.

Table 1 below indicates the types of academic-corporate partnership activities that U of A has undergone. There are two interesting notes to this list of activities. First, the specialized advisory committees created at U of A are not on the basis of particular technologies or industries, but on geographic regions. Given the tremendous diversity with the geographic region serviced by U of A, each regional campus has found it necessary to assess their educational needs and business partnerships within a smaller area. Second, U of A has no student internships. Most I/S students are employed full-time during their educational experience. Additionally, the senior project involves extensive industry contact. This combination of past and current business experience makes student internships less critical for U of A students.

Since U of A relies heavily on tuition funds, resources depend on student enrollments. The geographic region in which U of A functions has been going through difficult economic times. Thus, companies in the area have cut back on tuition reimbursements for employees. With private school costs being expensive and a large portion of I/S students depending on employers for tuition, economic conditions have impacted U of A's resources.

Since U of A's position on the partnership grid is on the right side of the Ad hoc activities area (Figure 2), this resource issue could be problematic. However, U of A has elected to pursue a variety of academic-corporate relationships that involve lower cost. They have opted for a variety of advisory committees that meet a few times a year and supplanted that knowledge exchange with a large number of corporate-based faculty. The partnership courses provide opportunities to work closely with corporate partners at little cost with maximum benefit for both the university and the students. These strategies have allowed U of A to engage in a variety of partnership activities and not stretch their resources beyond capacity. In addition, the business community gets extensive opportunities for input into the U of A curriculum and for knowledge exchanges.

Scenario 2 (U of B)

U of B is a mid-size public university located close to several small to medium size metropolitan areas with a fair number of medium to large corporations. U of B has created a regional Information Systems Senior Executives Council (ISSEC). This group functions as more than just an advisory board. Members pay a fee to become involved in networking, professional development and knowledge exchange with industry colleagues and the university. In addition, this group provides funding and support for the U of B IT Research Center. The Research Center provides a hub for both the exchange of funds and ideas among the participants. The ISSEC members are often site participants in university research projects. Likewise, the research Center hosts a variety of leading edge technology workshops and seminars that are of great interest to industry members.

U of B finds itself in the enviable upper right section of the partnership grid with many partnership activities and a substantial resource base. However, this success has not come about overnight. The U of B faculty began these industry-academia partnerships several years back with 3 to 4 corporate relationships. This initial advisory council then became the mechanism for acquiring additional members and resources. The council now consists of approximately 25 to 30 core members with several subcommittees sharing the variety of activities and issues being developed.

Again, the members of the ISSEC both support the university as well as benefit themselves from these partnership activities. For example, having good prior relationships with these companies facilitates the process of acquiring student internships. U of B has an understanding of the companies' needs as well as the skills and capabilities of U of B students for maximum advantage on both sides. Additionally, the industry participants are acquainted with U of B faculty and their expertise for assessing consulting projects and research collaboration.

Scenario 3 (U of C)

U of C is a private university located close to a fairly large metropolitan area. A total re-engineering of the I/S program at U of C was undertaken recently. Extensive involvement with the business community resulted in a program that received rave reviews from their corporate partners. Since there were no similar programs in the area and the business community felt that the curriculum provided students with skills that they would need in future years, the program was very successful.

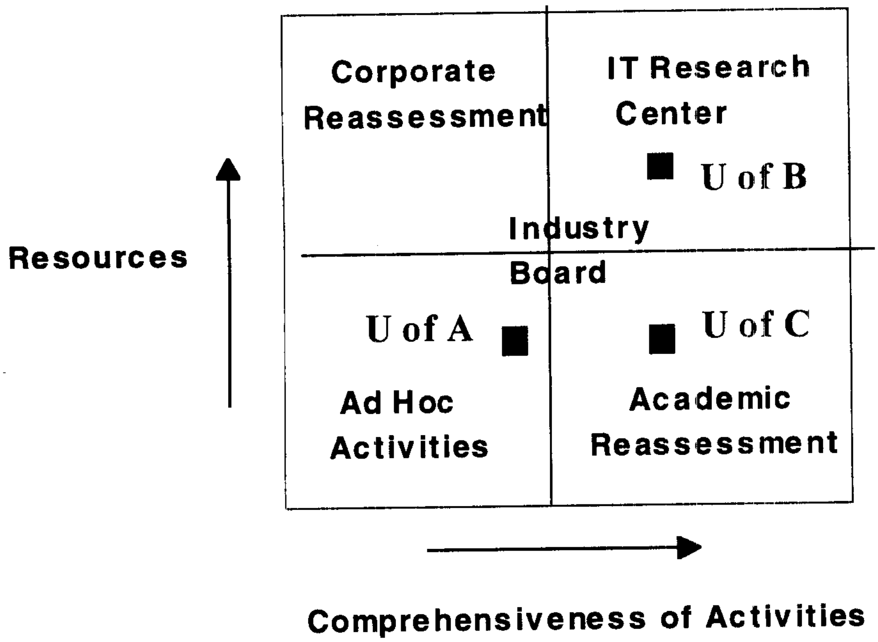
However, U of C is located in an area of declining demographics and stagnant economic growth. Although the new program is quite successful, additional efforts in marketing and maintaining student enrollments are necessary. In addition, the corporate involvement with the new program has resulted in renewed business community interest in U of C. The faculty at U of C has found themselves in the academic reassessment area of the partnership grid. Since they are a private school with heavy tuition dependence, declining or steady enrollments indicate scarce resources. In building interest and enthusiasm for the new program, U of C overcommitted faculty resources for partnership activities. Large numbers of student internships that require faculty oversight as well as faculty sponsored industry workshops are some of the activities that stretch faculty resources. New programs are time and energy consuming also.

With local industry stable or declining, large amounts of resources from the business community is not likely in the near future. Since U of C does not foresee their resource base changing dramatically, they are assessing the number and type of partnership activities they have currently. The goal is to move toward the left portion of the partnership grid by focusing on fewer activities with their corporate partners.

TABLE 1

Corporate/ Academic Activities	U of A	U of B	U of C
Curriculum Committee	X	X	X
Advisory Board	X		X
Specialized Advisory Comm.	X		
Partnership Courses	X		
Student Internships		X	X
IT Research Center			
Industry Workshops		X	X
Faculty Consulting		X	X

Figure 2.
Academic/Corporate Partnership Grid



CONCLUSION

To address the dramatic and continual changes taking place in the I/S field, educators must continually assess their I/S curricula. Concerted programmatic planning and action can add strength to flourishing I/S programs and critically improve prospects for greatly impacted programs. The goal for I/S programs should be long range with strategic plans to develop corporate involvement (see Figure 1). The approach might adopt some of the linkages described in these case studies or those in other successful I/S programs. Likewise, programs may create and implement new ideas customized to particular programs and surrounding corporate environments.

A growing partnership with industry offers many potential areas for increasing program revenues and enrollments. There are requests that can be made to close corporate partners for funding of faculty research, corporate seminars and workshops, faculty internships in corporations, student internships, technology grants, and student scholarships. Perhaps less obvious are the benefits of increased revenues through larger pools of students who are funded by their corporations and increased corporate marketing of programs.

In building I/S academic-corporate ties, it is important to recognize the potential to create knowledge enhancement that flows in both directions. The rich base of leading edge corporate technology, systems solutions, and management/organizational innovations can increase faculty and student knowledge to industry levels. At the same time, academic-based faculty can more easily realize the large opportunities to contribute their knowledge to corporate practitioners, working students, and corporate-based faculty. There is the potential for two-way information flows that can blend I/S theory and practice for current and future workforces.

The scenarios presented above obviously do not cover completely the variety of academic-industry relationships or situations that exist today. The have been presented to highlight the use of the partnership grid as one mechanism for assessing individual universities and industry relationships. Certainly, each institution must determine their current location on the grid, their future objectives and any mitigating circumstances. Programs may look to successful partnerships within similar universities or create and implement new ideas customized to particular programs and surrounding corporate environments. An additional factor in developing or changing partnerships is determining a realistic time frame for moving to a desired grid location.

In summary, many academic institutions recognize the importance and value of academic-industry relationships. The partnership grid presented here is one strategy for beginning the process of developing those partnerships or for assessing current relationships and their long term survival.

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CLOSING THE GAP BETWEEN ACADEMIC DEGREE PROGRAMS AND INDUSTRY EXPECTATIONS

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ABSTRACT: Industry and academia have different ideas about what should be taught in CIS degree programs. These different views have been called the perceptual gap in CIS education. The perceptual gap is becoming larger because of the accelerating pace of technical development. This paper focuses upon the perceived gap between the many academic degree programs and the expectations of industry practitioners, and how to close the gap.

INTRODUCTION

There has been a long-standing debate in the CIS field about the content of collegiate CIS degree programs. The debate is over what should be taught in the programs.

There are two opposing views: Academics tend to believe that the fundamental, underlying principles of the information systems field of study should be emphasized. Industry, on the other hand, tends to believe that academia should be preparing students for their first job, and that academia teaches the obsolescent languages and methodologies of the past, and ignores the technologies of the present. Industry seems to prefer vocational training that is closely related to current practices, so students are prepared for their first jobs (Davis, 1989; Hartog, 1985).

This difference in views is called a perceptual gap between the expectations of industry and what academia teaches (Trauth, Farwell & Lee, 1993). The continued existence of the gap (Zachary, 1995) is sufficient justification for academia and industry to work together to close the gap; and is the subject of this paper.

THE PROBLEMS CONTINUE

The perceived gap between what technical tools and skills the colleges and universities offer and what industry expects the graduates to be able to do raises four major questions: First, what curricula should be used to guide the degree programs for business information systems majors? Second, what technical training should the colleges and universities offer? Third, what help should industry provide to ensure a supply of trained, skilled CIS graduates? And fourth, how can colleges and universities acquire the latest technology for their academic programs when budgets are shrinking?

What Can Be Done?

A recent study found that closing the gap requires the cooperation of all of the stake holders, the faculty, students, managers, and practitioners of information systems (Trauth et al., 1993). Each of these groups has an interest in closing the gap, and all of them must work together to close the gap.

Smaller Schools and Degree Programs

Many colleges and universities are experiencing falling enrollments, especially in technical fields of study such as the CIS field (Cale, Mawhinney & Callaghan, 1991; Davis, 1989; Mawhinney, Cale & Callaghan 1990; Ostling, 1992; Trower, Willis & Dorsett, 1994).

The declining birth rate is often cited as the main reason enrollments are falling (Davis, 1989), but this declining enrollment trend could soon reverse itself. There is a short period of an increased number of new students expected soon (Putka & Lubman, 1995).

Another reason for smaller enrollments is the fact that some students lose interest in computing careers (Barrier & Margavio, 1993). Another reason is the fact that the field of study is difficult (Alexander, 1993; Barrier & Margavio, 1993). Another reason is that some students do not know enough about the CIS degree program and the career opportunities (Trower, et al., 1994), and another is that fewer students are prepared to enter the computing academic field (Bennet, 1993; Campbell & McCabe, 1984; Duke, 1994; Leo. 1993; "U. S. students," 1992).

One implication of the smaller enrollments in computing degree programs is that it may become hard to justify them as separate degree programs. Some colleges and universities have already combined a few degree programs, and this trend is expected to continue (Putka, 1995, Stecklow, 1994, Vozzella, 1995). Some educators and legislators are predicting a smaller education system at all levels in the future (Graham, 1994; Ostling, 1992)

Shrinking budgets

Another implication of falling enrollments is that budgets will shrink. Smaller budgets mean that it will become harder to acquire the technology needed for CIS degree programs (Cale, et al., 1991; Davis, 1989; Mawhinney, et al., 1990; Ostling, 1992).

Smaller college and university budgets mean that the money allocated to academic departments is also a smaller amount. Less money for the CIS department makes it harder to hire additional faculty, to satisfy current faculty, and to purchase new technology. Closing the gap when budgets are shrinking requires finding or creating new, imaginative ways to acquire technology (Couger, 1993).

CURRICULA AND THE GAP

The question of what curriculum to select is important because a model curriculum gives order and direction to a professional degree program. A curriculum can even help justify the acquisition of new technology. CASE tools, for example, were called for in the DPMA IS '90 curriculum; and many schools used that as an argument to request funds for buying CASE tools.

Selecting a curriculum raises an important question that must be addressed. The question is which curricula to select? There are so many curricula to choose from that it is difficult to make a selection.

Confusing Curricula and Terms

Several computing curricula have been proposed by professional organizations such as the Association of Computing Machinery (ACM), the Institute of

Electronics and Electrical Engineering's (IEEE) Computer Society, and the Data Processing Management Association (DPMA). Many of the curricula have similar names, titles, and components which makes the choice among the curricula difficult at best (Cox, 1990; Hartog, 1985).

The confusing names include computer science (CS), computer science -engineering (CSE), computer information systems (CIS), information systems (IS), business information systems (BIS), business computer information systems (BCIS), management information systems (MIS), and data processing (DP). All of these names are used, sometimes interchangeably, to describe degree programs and jobs in both academia and industry. The indiscriminate use of these terms is what makes the choice difficult (Hartog, 1985).

The Curricula Time Lag

The use of the DPMA model curriculum or any other curriculum raises another problem. The DPMA's IS '90 model curriculum was released in 1990. A new DPMA model curriculum is about to be released in 1995, five years after the last DPMA model curriculum was released.

Technology does not wait upon academia (Longnecker & Feinstein, 1991). Technology changes occur faster than curriculum changes. This means that the curricula have to be general enough in content and descriptive language to permit the adoption of any new technology that is developed after the curricula are released.

Selecting Curricula

Although curricula are central to the establishment of an undergraduate degree program in CIS, there is no single source that identifies, classifies, and rates the available professional degree curricula (McCubbin & Mathews, 1993).

There is some help available. Some recent studies indicate that the DPMA model curriculum is preferred by many colleges and universities, especially business colleges and universities. A study of 161 American and Canadian schools offering a CIS degree program found that over half of them use the DPMA model curriculum or a hybrid version of the DPMA model (Longnecker & Feinstein, 1991). Another study found that the majority of AACSB accredited schools in the study use the DPMA model curriculum (IS '90) which is considered to be more suited for business applications than the ACM degree program (McCubbin & Mathews, 1993). A study of 26 different colleges and universities also found that more than half of them use the DPMA model curriculum, or a modified version of the DPMA model curriculum and the ACM model curriculum (Heiat, Heiat & Spicer, 1993).

WHICH TECHNOLOGY TO SELECT?

The choice of technology must consider what technology is available, the cost of the available technology, and whether or not it is a fad. The choice of technology also relates to the question of which curriculum to select because the technology must support the curriculum.

Avoiding Technology Fads

Academia is acutely aware of the problem of potential technological obsolescence and the pressures it can exert on a department's budget and curriculum. It is very difficult to stay current with the technology of computing, given the budgetary constraints on academic resources; but keeping up with technology is necessary for a successful academic program (Shorter & Dean, 1994).

Academia cannot wait for the next version of a curriculum to guide it into new technology. Academia cannot afford to follow technical fads, either; and must avoid trying to offer a new course every time a new technology is developed. It is important to strike a balance between fundamental knowledge and technical skills, to teach the concepts of information systems as well as the best and latest technology that is reasonably available (Cohen, 1993; Katz & DeMichiell, 1992).

Which Skills Are Important?

There is another debate about what non-technical skills must be part of a CIS degree program. Some authors agree that interpersonal skills, communications skills, and the ability to work together are important (Crocket, Hall & Jeffries, 1993; Martin, 1995; Mawhinney, Morrell & Morris 1994). One study found, however, that although many in industry say these skills are important they tend to select employees because of their grades and technical qualifications. This was apparently due to the difficulty of measuring the desired interpersonal skills. As a result, grades and technical skills are used to screen prospective employees; and the interpersonal skills are considered later (Crocket, et al., 1993).

When to Change Technology

The naturally appearing sigmoid model, or S-curve, has been widely applied to products and organizations to show growth and change. It is also applicable to the introduction, growth, and acceptance of internal organization changes or functions. The S-curve depicts a natural cycle of birth, growth, maturity, and decline. The S-curve has also been called the life cycle model, the growth model, and the learning model.

James Martin and Carma McClure (1985) used the S-curve to demonstrate two crisis periods followed by two periods of solution and recovery for applications development. They said that the crisis and recovery periods follow a pattern similar to the S-curve or the life cycle model.

An important concept of the S-curve model as it is used in economics is that once an organization reaches the portion of the curve where there are diminishing returns, it cannot return to satisfactory economies of scale without changing its technology or means of production. The pattern of growth and maturity followed by a technology shift can be seen in the first three computer generations that were based upon vacuum tube technology (first generation), transistors (second generation), and integrated circuits (third generation).

In 1990, Yourdon said that the structured development methods of the 1970s, which he had helped create, had reached maturity, and that improvements in the methodology had slowed by 1986. Yourdon used the S-curve to explain his change, and said that the stagnation of the structured paradigm indicated it was time to change to a new technology, a new paradigm for applications development. As a result, he became a proponent of object-oriented applications development.

Yourdon (1990) stated four factors or questions to consider when considering changing technologies or paradigms:

1. Is it mature and well developed as a paradigm?

2. Is a good implementation technology available?

3. Is the organization sophisticated enough to change to the new paradigm?

4. Are the systems and applications being developed the sort to best use the new paradigm (thus ensuring some degree of success)?

These factors should be considered by colleges and universities before new technologies are acquired in order to avoid chasing fads that have no lasting value. The questions should also be asked in order to avoid changing to new technologies before they are well developed and generally accepted.

ACQUIRING NEW TECHNOLOGY

The question of what technology training to provide relates to the question of what help industry should provide in order to insure that there will be a steady supply of new, trained, entry-level graduates. It also relates to the question of how colleges and universities can acquire the necessary technology to support their degree programs.

Faculty Incentives

Although budget constraints play an important role, another factor may limit the acquisition of new technology. Tenure, promotion, and pay increases are usually based more upon research and writing for publication than upon teaching, classroom performance, and service.

Acquiring new technology is often considered service to the institution, and does not count very much in tenure and promotion considerations. As a result, there is little reason for tenured faculty to acquire new technology and integrate it into the degree program.

This attitude on the part of academia is a problem because industry has an interest in students who acquire specific skills while in college. Industry wants to hire graduates with a technical degree from a program that teaches and emphasizes current tools, practices and methodologies (Trauth et al., 1993, Zachary, 1995).

The need to close the technology gap means that academics must seek new technology. The need to fund new technology through non-budgeted methods means that the attitude of academia about the value of service such as the acquisition of new technology may have to change.

Closing the gap

Closing the gap requires the involvement of all of the stake holders, the people and parties, affected by the technology gap (Trauth, et al. 1993).

Closing the gap also requires improving industry and alumni relations and encouraging closer ties with industry through visits, joint ventures, professional associations, and operating technology research centers with and for industry. Closing the gap also requires joining professional organizations and attending their meetings, holding office, and volunteering time.

Some other ways to improve relations with industry include conducting professional training programs, sponsoring contests and special events with industry, holding joint meetings, publicizing campus honors, awards, events, and activities.

These and other new ways of improving academia's relations with industry have to be found and tried. Closing the gap requires that both academia and industry make attempts to communicate better, and these are ways to open communications.

Non-Budgeted Acquisition Methods

New ways to acquire technology will have to be found if budgets continue to decline. Some alternative ways to acquire new technology include: Partnerships with industry vendors; partnerships with users or consultants; gifts from industry, users, alumni, and others such as student clubs; and the use of student lab fees to acquire new technology.

Although schools often have to use budgeted money to join a partnership with a technology vendor, this method can also be used as a non-budgeted way to acquire new technology. Many vendors encourage such partnerships, and schools can sometimes join them by getting gift funds from non-budgeted sources, such as local technology users to join partnerships.

Other off-budget sources of funds include gifts from industry, users, alumni, and others such as student clubs. These funds can also be used to acquire new technology.

Student lab fees, which are also non-budgeted funds, are usually used to run and maintain existing technology; but lab fees can also be used to acquire new technology. This is a matter of interest in many schools, and one major university is studying the addition of a technology fee. The proposed technology fee is to be used to pay for acquiring new technology (Houston Carr, personal communication, February 1995).

The established methods of raising money through partnerships, gifts, and fees should be promoted by CIS departments to acquire new technology; but new methods are needed, too. Imagination and marketing are needed to identify and develop other ways to acquire new technology (Couger, 1993).

CONCLUSIONS

College and university enrollments are declining due to a variety of reasons including fewer college-age students, and more competition for the fewer numbers of students. Enrollment in CIS programs is also declining. The implication is that a reduction in size may be forced upon academia by the smaller numbers of entering students. The eras of great growth are ending and CIS departments must become competitive to continue to survive as a viable degree program.

The DPMA model curriculum is considered to be best suited for an undergraduate CIS degree program, but whatever curriculum is selected must be supported by current technology. CIS departments must seek the best and latest technology to train students for both the careers ahead of them and the jobs they get upon graduation.

Budgets are shrinking, technology is changing and colleges and universities must seek new ways to acquire the technology to support their programs. They must place more emphasis on acquiring new technology and give more credit to faculty members for acquiring the technology.

As always, budget constraints will force CIS departments to seek alternative sources of funds for adding new technologies to the courses and degree programs. Partnerships, gifts, student fees, and other non-budgeted methods to acquire new technology will become more important as budgets continue to shrink.

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Levels of Satisfaction with Pre and Post Installation Vendor Contact: Their Effect on Small Business Tertiary Information Technology Course Requirements

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ABSTRACT

This paper examines the effect on curricula inclusions of small business management's satisfaction with vendor pre and post installation service. The study uses a widely accepted group of 15 potential subjects and examines the rating of these by small business managers. The study also compares the ratings of these subjects in terms of whether the small business manager expresses satisfaction or dissatisfaction with vendor pre-installation services (delivery of equipment, vendor supplied information concerning the technology to be acquired, equipment suitability) or post-installation services (manuals, training, vendor after sales service). Results show that the level of satisfaction with pre-installation vendor services only affect those subjects deemed most important, while the level of satisfaction with post-installation vendor services affects only those subjects deemed not so important.

INTRODUCTION

Over the past decade, with the cost of computer technology decreasing, there has been a readiness for small business to adopt computer technology into their day-to-day running. MacGregor & Cocks (1994) report in the Australian Veterinary Industry an annual growth rate in the use of computers of 11% over the last five years. Similar figures have been reported in small businesses in Denmark, Greece and Ireland (Neergaard 1992). While the desire for small business to adopt information technology has increased, the skill and knowledge required by most small business managers to plan, implement and maintain that technology has, up until recently remained minimal. Thus most small businesses have tended to rely on vendors for the necessary background knowledge to purchase and use computers.

Recent studies (Yap et al 1992, Holzinger & Hotch 1993, Delvecchio 1994) have suggested that not only is there a heavy reliance, by small business, on vendor expertise, but that, very often, the vendor fails to understand the nature of the small business, leading to dissatisfaction with acquired technology.

In an examination of the Australian Veterinary Industry, MacGregor & Cocks (1994) found that dissatisfaction with vendor groups, not only affected ongoing use of computer technology, but also affected the rating of subject inclusions in tertiary IT courses. In particular they found that dissatisfaction with vendor services which may be termed 'pre-installation' (delivery of equipment, vendor supplied information concerning the technology to be acquired, equipment suitability) tended to affect the rating of those subjects deemed most important inclusions in a tertiary IT course. By comparison, dissatisfaction with vendor 'post-installation' service (manuals, training, vendor after sales service) only affected those subjects deemed less important by the profession.

This paper begins by briefly examining the nature of small business. It then examines small business's IT curricula needs. Finally, it is hypothesized that, in line with the veterinary findings, the level of satisfaction with pre-installation vendor service will affect those subjects deemed most important by the small business community, while the level of satisfaction with vendor post-installation services will affect those subjects less important to the small business community.

The Nature of Small Business

The nature and circumstances of small business has been the topic of both governmental committee findings as well as research initiatives. Brigham & Smith (1967) found that small businesses tended to be more risky than their larger counterparts. This view is supported by later studies (Walker 1975, Delone 1988). Cochran (1981) found that small businesses tended to be subject to higher failure rates while Rotch (1987) suggested that small businesses tended not to maintain adequate records of transactions. Perhaps most important in any discussion concerning small business is the view given by Barnett & Mackness (1983), that small businesses are not miniature versions of larger businesses, but quite unique in their own right.

A recent study (Reynolds, Savage & Williams 1994) provided a comprehensive list of features which uniquely pertain to small business. This list included:

* lack of specialist staff
* informal and inadequate planning and control systems
* lack of control over the business environment
* limited process and product technology

When the introduction of IT into small business is considered, there are marked differences between small businesses and their larger counterparts (Barnett & Mackness 1983). Khan & Khan (1992) suggest that most small businesses avoid sophisticated software or applications. This view is supported by studies carried out in the United Kingdom by Chen (1993). Cragg & King (1993) suggest that small businesses often lack the necessary expertise to fully utilize IT. This view is supported by the findings of Holzinger & Hotch (1993) and Delvecchio (1994). Indeed, Yap et al (1992) have shown that many small businesses use consultant or vendor expertise in the identification of hardware and software as their first critical step towards computerization. They conclude that ongoing success with IT is positively associated with vendor support, vendor training, vendor after sales service and vendor expertise. This is supported in recent studies (MacGregor & Cocks 1994, Wood & Nosek 1994, MacGregor & Bunker 1995).

Not only are there a myriad of views concerning the nature of small business, but from a governmental standpoint, there are a variety of definitions of small business. In the United Kingdom a small business is defined as:

> 'having fewer than 50 employees and was not a subsidiary to any other company'

In the United States:

> 'a small business concern shall be deemed to be one which is independently owned and operated and which is not dominant in its field of operation' (United States Small Business Administration- based on section 3 of the Small Business Act 1953)

While in Australia, a small business is defined as:

> 'small business is one in which one or two persons

are required to make all the critical decisions (such as finance, accounting personnel, inventory, production, servicing, marketing and selling decisions) without the aid of internal (employed) specialists and with the owners having knowledge in one or tow functional areas of management' (Meredith 1994, p.31)

Computer Curriculum Requirements

Based on ACM and DPMA curriculum models, Lo (1991) suggested that in order to fully examine all possible curriculum inclusions, decisions needed to be made across 51 subjects. These subjects have been utilized in a number of studies both in Australia and South East Asia (Ang & Lo 1991, Ang 1992). Seeborg & Ma (1989) suggested that when non-computing groups were considered, the number of subjects should be considerably reduced. As such, Lo's original 51 subjects has been reduced to 15 (see table 1).

Hypothesis

In line with the study carried out with the Australian Veterinary Profession, two hypotheses are tested:

$H1_0$ The level of satisfaction with pre-installation vendor service (delivery of equipment, vendor supplied information concerning the technology to be acquired, equipment suitability) will not affect the rating, by small business managers of those subjects deemed most important in a tertiary IT course.

$H2_0$ The level of satisfaction with post-installation vendor services (manuals, training, vendor after sales service) will not affect the rating by small business managers of those subjects deemed less important to a tertiary IT course.

Survey Instrument

A mailing list was developed by the Illawarra Chamber of Commerce. The geographic area covered included the southern suburbs of Sydney, the cities of Wollongong and Nowra (Population approx. 5000,000). The sampling frame developed was companies with a work force less than 50, where the company was not a subsidiary of a larger company. Since the survey was examining vendor effect on small business, computing companies were excluded from the survey group.

Small businesses were categorized into one of four types, these categories being gleaned from the directory:
Finance includes investment and tax consultants, accounting firms and insurance brokers
Industrial includes manufacturing, building and construction industries
Customer Service retail, transport, tourism, media
Professional architects, medical, surveyors, legal

A questionnaire was developed which sought information on the type of small business. Respondents were asked to rate each of the subjects (1 not important to 5 very important) as inclusions to a tertiary IT course. Additionally respondents were asked to rate their dealings with vendors

(satisfactory or unsatisfactory) in the following:

* delivery and installation of computer equipment
* availability of information concerning computer technology
* satisfaction with equipment and software
* computer systems changes
* computer systems training
* computer systems documentation
* computer problem rectification

Analysis of Results

A total of 600 questionnaires were distributed. Responses were obtained from 131 businesses, representing a response rate of 21.8%. All respondents indicated that they were using IT in their day-to-day work. Table 2 indicates the responses subdivided into business type. Table 3 provides an overall summary of responses concerning small business managers' perceptions of vendor services. Table 4 is a summary of responses by veterinary practitioners and small business managers showing the importance of each of the subjects.

An examination of introductory computing courses offered to professionals suggests that they normally offer no more than 6 subjects (MacGregor & Cocks 1994). It is instructive to examine which six subjects are required by each of the small business groups (see table 5).

Table 6 indicates those subjects affected by the level of satisfaction with vendor delivery and installation of equipment. Table 7 indicates those subjects affected by satisfaction with information provided by the vendor regarding the suitability of equipment and software. Table 8 indicates those subjects affected by the level of satisfaction with the newly acquired equipment.
Table 9 shows the effect of satisfaction/dissatisfaction with after sales changes to the system on the rating of subjects.

Satisfaction/dissatisfaction with vendor training appeared to affect only one subject - Marketing (see Table 10). The level of satisfaction with vendor manuals and documentation appeared to only significantly affect one subject - Statistics (see table 11).

Discussion

Hypothesis 1 ($H1_0$) posited that the level of satisfaction with pre-installation vendor services (delivery of equipment, vendor supplied information concerning the technology to be acquired, equipment suitability) would not affect the rating, by small business managers, of those subjects deemed most important in a tertiary IT course. An examination of tables 6, 7 and 8, in conjunction with the list of subjects deemed most important in a tertiary IT course (table 5), shows that only those subjects deemed most important appear to be affected by the level of satisfaction with pre-installation vendor service. In all cases, those respondents who indicated that they were satisfied with the vendor services rated the subjects higher than those who indicated dissatisfaction.

If we consider each subject individually, it can be seen that while Business Accounting Systems is affected by all three pre-installation measures, by far, the most significant effect on the rating of this subject is satisfaction with vendor delivery and installation of equipment. By comparison, the subjects Information Analysis and The Use of Databases and Spreadsheets appear to be equally affected by the delivery and installation of equipment and satisfaction with the equipment itself. In contrast, the subjects Business Analysis, Management Principles and Finance are only affected by one of the pre-installation criteria (delivery of equipment, vendor information and satisfaction with equipment respectively). It is interesting to note that only two subjects within the group considered most important in tertiary IT courses, Accounting and Office Automation were not affected by levels of pre installation vendor services.

Based on the results in tables 6, 7 and 8 the null hypothesis $H1_0$ is rejected, i.e. the level of satisfaction with vendor pre-installation services only affects the rating of subjects deemed most important in tertiary IT courses directed towards small business managers.

Hypothesis 2 ($H2_0$) posited that the level of satisfaction with vendor post-installation service (manuals, training, vendor after sales service) will not affect the rating by small business managers of those subjects deemed less important to a tertiary IT course. An examination of tables 9, 10 and 11 in conjunction with the rating of subjects (table 5) shows that only those subjects outside the group considered most important are affected by the level of satisfaction with vendor post-installation service. Again it would appear that those respondents who indicated that they were satisfied with vendor post-installation services rated subjects higher than those who expressed dissatisfaction.

Based on the results of tables 9, 10 and 11, the null hypothesis ($H2_0$) is rejected i.e. the level of satisfaction with vendor post-installation services (manuals, training, vendor after sales service) only affects the rating by small business managers of those subjects deemed less important to a tertiary IT course.

Conclusion

This paper has focused on factors affecting curricular inclusions for an IT course applicable to small business. The study used a number of factors previously show to affect the user's perception of satisfaction with computer technology. These were applied to a widely accepted group of subject inclusions to determine the effect of these factors on subject ratings.

The results show that the type of experience associated with vendor groups can significantly affect the rating of certain subjects.

A number of studies (Yap et al 1992, Holzinger & Hotch 1993, Delvecchio 1994) have shown that many small businesses seek external help when dealing with IT. These studies have further shown that very often the external help agent fails to understand the business resulting in the lowering of satisfaction with the newly acquired computer technology. This study has shown that not only is there dissatisfaction with external vendor groups, but that this dissatisfaction significantly affects perceptions of curriculum design and curricula inclusions.

In particular the study has shown that dissatisfaction with pre-installation vendor services can have a significant effect on subject inclusions which might be considered mandatory to a tertiary based IT course, while dissatisfaction with post-installation vendor services appears only to affect the less mandatory subject inclusions.

This study has presented a number of factors which affect curricula inclusions. Although the results have important implications, additional research is required in a number of areas. Firstly, the reasons why certain measures of satisfaction only appear to affect certain subjects. In order to pursue this, these factors need to be refined and followed up by extensive interviewing. Perhaps more importantly, a more intensive examination needs to be carried out to examine how small businesses communicate with vendors, such that the effect of various measures of satisfaction may be better explained.

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Furnished upon request.

The Internet: Fundamentals of Security and Control

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Abstract

This discussion investigates the present and future ramifications of The Information Superhighway, more commonly referred to as "The Internet." Computer network security issues are explored including criminal activity by both hackers and crackers, encryption, firewalls, viruses and the influence each of these have on the increasing subscriber base. Government versus private industry control of this resource is explored, with sections on the original intended use of the Internet, Government policy, current legislation, ethics and social protocol

What is the 'Net? Who is using it?...

"The Information Superhighway," "The National Information Infrastructure," "Internet," "The 'Net," "The Data Highway" ... to what are they all referring? The Internet (with a capital "I") is a world-wide computer network made up of thousands of smaller networks linked together. This fascinating notion of world-wide connectivitiy through voice, data and video has become a reality, and as with any type of new development, it introduces benefitial and adverse elements. The proliferation of articles on this subject, published everywhere from small-town newspapers to national and international publications, make the Internet one of the most widely covered but, strangely, least understood phenomenons. Those of us who speak the jargon nod our heads sagely while reading articles on the Internet and it's far-reaching future ramifications. But the Internet is no longer the exclusive vehicle of techno-educators, military or government. It is coming to light that Jane and John Q. Public must not only understand their participation with the Internet, but must also safeguard themselves against possible harm in an arena which has few laws to protect them.

Originally developed to ensure government communication in the event a nuclear attack destroyed part of the country, in its early days the Internet was used by the military, government and universities. It was a unique research tool that allowed scientists and university researchers to converse and trade ideas on common themes. It was then realized that it was an easy way to leave messages and electronic mail became one of the chief uses. With the addition of students, businesses, and private citizens, Internet usage has increased exponentially. According to a report released by the Internet Society, the number of machines connected directly to the Internet, or "hosts," has increased 81% from July 1993 (1.78 million hosts) to July 1994 (3.2 million hosts).[12] Access to the Highway is also much easier and user friendly today. In a world where the average citizen can send a message to the President via *whitehouse.gov*, it does seem that the world is indeed shrinking.

Businesses have begun to realize that the Internet could be used to their strategic advantage. Advertising services and products on the Internet could increase their market span and market share. A few examples include:

- Digital Equipment has formed an Internet Business Group to gather its Internet related services and products under one division which will focus on their effort to conduct business over the Internet.[13]
- A recently formed company called First Virtual Holdings is reported to be seeking ways to foster business by providing a system for electronic transaction automated accounting. [14]
- NovX, Inc. has developed a line of Internet servers which will be sold to businesses. These servers, based on Internet standards, enable businesses to market their products over the Internet.[11]

Uncurtailed Growth / No ownership

It is probably safe to say that few people imagined the unbelievable growth of the Internet, and it's subsequent control issues. At this time, the Internet is not owned by anyone -- it belongs to everyone. It began as a government subsidized experiment which has taken off, with estimates of 150,000 to 200,000 new users a month and is governed by a voluntary board with no powers of enforcement. Netiquette, or the etiquette adhered to in this "underground" world, was developed in a patchwork fashion, is difficult to follow, and unforgiving of breaches. Issues of development, access, protocol (both technological and social), control of facilities/services, and security have been explored in magazines and trade journals in an effort to get a mental grip on the overall picture of the Internet.

Ethics: In InternetSpeak, the term "spamming" the network is the physical equivalent of dropping a can of Spam into a fan and covering the available space with the contents. Spamming the network occurs when a single message is sent to every available bulletin board on the Internet which posts messages to the users. The issue of whether or not this is ethical came into view when Canter and Siegel, two Arizona lawyers, wrote a program to send a message to every bulletin board on the Net. The message was an advertisement for their services to aliens in search of a green card. Howard Rheingold, author of *The Virtual Community* compared this to "opening up your mailbox and finding 'a letter, two bills and 60,000 pieces of junk mail.' " Almost immediately, Internet users responded by sending (again, InternetSpeak) "flames," or nasty electronic mail responses, by the thousands. A user in Australia sent 1,000 bogus requests for information each day and a 16 year old threatened to burn their law firm to the ground. Internet Direct of Phoenix, which provided the lawyers with their account, canceled their account because the volume of traffic grew to such a point that the system crashed repeatedly. Unrepentant, Canter and Siegel stood their ground and stated that they would do it again. As if on cue, the harassment began anew. Their fax machine began to print hundreds of blank pages, phony magazine subscriptions were sent to them, and a Norwegian programmer developed a "cancel-bot," a theoretical robot that roams the Internet looking for Canter and Siegel mass distributions and deletes them before they can be sent.(2) Which is more unethical, the original message or the response? As things stand right now, the answer is neither. Although the Internet was not designed for this particular type of use, there is no central control for its usage. There are social protocols which exist on the Net, but these were developed in an ad-hoc fashion by the powerless volunteer governing body and by users themselves. The government has proposals for control of access and use of the system, but there is much controversy over this.

Of great concern to users is the proliferation of pornographic materials distributed through the system. Carnegie Mellon University had planned to drop sex-related Usenet conferences from the Campus access because they were worried that the Usenet groups could violate a Pennsylvania law against distribution of sexually explicit materials to minors. After protests from students and users around the world, the university changed their plans. A university taskforce was set up to study the issue and to decide on conferences carrying sex-images.(16) Where is the control? Perhaps control is a result of pressure from groups wanting access to this type of material. In an effort to be objective, free speech proponents have a valid point in that they have a right to speak and other people have a right <u>not</u> to listen. The same laws that prohibit the distribution of hard-copy pornographic materials should also apply in this situation.

Another recent example of unethical usage of the Internet was reported in the February 11, 1995 issue of the *Daily News-Record* in Harrisonburg, Virginia. A student of the University of Michigan protested his arrest, in which he was charged with interstate transmission of a threat to injure, by claiming the first amendment. Jake Barker, the suspect, allegedly posted a message on the Internet which described his desire to harm a fellow student. One of the posted messages included "Torture is foreplay, rape is romance, snuff [killing] is climax." It is further reported that Barker named the student who was the object of the message and exchanged messages via the computer with another man regarding the details of carrying out his sick fantasy. Judiciaries are now required to blaze new trails in the courtroom to deal with this and other types of computer-assisted crime. With few precedent cases currently on the books, it is unclear how each new occurrence will be handled by our justice system.

With expansion of services and uses, conflict on regulating and policing the Internet is inevitable. The Internet was intentionally built without a central authority. As a result, no one owns it, operates it, or has the power to prohibit its usage to anyone.[2]

Control: Government seems to have taken the stance of supporting a privately owned information highway. This would indicate that the government is ready to turn over a large public investment into the hands of a few private corporations, thereby relinquishing control of this vast resource. The government's faith in these corporations could be misplaced. Neither complete government control nor complete private control should be the answer. Rather, there should be a partnership between the two to ensure that this achievement be accessible and affordable to all. The 1934 Federal Communications Act stated that broadcasters were required "to operate in the public interest, convenience and necessity," which seems to indicate that large corporations would not always act in the best interest of the public. Corporations appear to believe that the public wants Internet access to provide interactive television and information services for video on demand and home shopping. Surveys portray a public which is more interested in on-line education, voting services and obtaining reference materials. These services have typically been provided by public institutions, not private businesses. There is precedent in existence to provide the foundation for the laws that should govern a partnership between private and public industries. Perhaps the most relevant example is the library system. Libraries are publicly funded so that information is available to everyone. With an on-line information system, public access is essential and private control and ownership may not provide universal access. The telephone system is another example of a private business under heavy regulation of the federal government. Private industries should not be prohibited from making a profit on the information superhighway, as long as the information is available to all.[3]

Government Policy: On September 15, 1993, the Clinton Administration proposed the formation of the Information Infrastructure Task Force (IITF) comprised of federal officials and a US Advisory Council on the NII, made up of 25 private and public sector appointees Their goal was to reform communication regulations, promote private sector investment, ensure that all citizens would have access to the NII, and promote applications in public services such as government services, education and health care. In addition, they were to focus on security and reliability issues of the network, protection of intellectual property rights and management of the system.

Other movements on the legislative level include the review of rulings against Regional Bell Operating Companies (ROBC's) owning and operating their own cable services. This is a step in the right direction of allowing universal access of the services possible on the Information Superhighway[6]

Laws & Litigation: Exploration of a different aspect of network security warrants discussion. In our litigatious society, many people do not understand the significance of electronic mail and its impact on how freely users express themselves. Investigative firms are formed by the score which specialize in the discovery and restoration of old electronic mail. Currently, most courts regard electronic mail as evidence much the same way that they consider paper evidence. Federal rules for civil cases adopted in December, 1993 now include electronic mail as part of discovery in the pre-trial process.

Why is electronic mail cause for alarm? Most people do not understand the concept of sending messages via electronic mail. Users erroneously assume that the communication is confidential and therefore read only by the intended party. A network, by its very nature, is an open forum. While a message has a distinct destination address, it must pass through mediums which are not secure and, therefore, vulnerable to interception. One famous case involving TV personality, Roseanne, and her then-estranged husband, Bill Petland, outlines the personal consequences of indiscreet electronic mail. A gag order placed on Petland dictated that he not discuss their divorce. Unfortunately for Petland, derogatory electronic mail messages sent to a third-party via Prodigy landed in the hands of her lawyers, who are now challenging the multi-million dollar divorce settlement. Yet another victim of his own electronic mail is Los Angeles police officer, Lawrence Powell. Powell, one of the officers accused of beating Rodney King, was questioned regarding a message uncovered after the beating which said: "Oops, I haven't beaten anyone so bad in a long time."

Those with the "deepest pockets" -- corporations -- should be very concerned with reckless electronic mail. Microsoft Corp. is finding out the hard way that electronic mail is extremely difficult to "explain away." A former employee, Karen Strauss, charged Microsoft with a gender discrimination suit which alleges that she was not promoted because of her gender. Court documents reveal that Strauss said her manager, Jonathan Lazarus, sent offensive electronic mail to her and other staff that contained explicit sexual references. In another case, Borland International has brought suit against Symantec Corp., complaining of theft of trade secrets when it uncovered electronic mail allegedly sent by a former employee containing confidential trade information.

An indirect form of communication, users often do not exercise verbal (more accurately written) constraint in sending electronic mail when it is appropriate to a given situation. People are very brave when not in a direct face-to-face confrontation. Since written communication cannot imply voice inflection, facial or body expressions, misunderstandings can be extremely common. Netiquette dictates that CAPITAL LETTERS IMPLY SHOUTING (which is very irritating to other users), and exclusive use of lower case letters implies laziness (a common crime punishable by 'flames'). Innovative users have developed quirky keyboard euphemisms for facial expressions such as a "smiley face" **:-)** and a frown **>:-(** which aid them in conveying the true nature of their meaning. All things considered, users should beware that it only takes one person to be offended by the content of a message to find themselves in a law suit.

Some companies are under the mistaken impression that by simply deleting electronic mail all traces cease to exist. Computer activity is most often backed up on magnetic tape in case a calamity destroys all or part of the database. Part of this process is the storage of all instruction codes to add, delete and modify information. Therefore, it is extremely likely that deleted information can be recovered by either direct tape back-up or the restoration of instruction code. Depending upon the nature of the incident, businesses are either in a good position to recover evidence of an employee's misdeed or are at liability to explain their own actions. There is currently no clear-cut law in the United States regarding the destruction of electronic mail by businesses. Policy is different from state to state, but it is commonly understood that destruction of electronic mail is similar to destruction of paper evidence if a business is involved in a law suit.

Security Issues

There is an incredible amount of controversy over security on the Information Superhighway. Most people believe that data encryption is the only valid option. There are numerous measures available to help attain a "somewhat" secure computing environment. The best analogy that comes to mind is that of a normal city as compared to a large computing environment.

In a large city, it is impossible to be completely safe. The police cannot be everywhere and the cost of having a police officer on every corner would be too prohibitive. Even if that were the case, it is possible to eliminate their safety measure by removing them. To support this point, consider a city such as New York. The city is made up of 5 boroughs -- Manhattan, Brooklyn, Staten Island, Queens and the Bronx. Each borough is made up of distinct neighborhoods. Because the police cannot be on every street, some neighborhoods have come up with "Neighborhood Watch" programs where private citizens keep an eye out for anything abnormal going on in their neighborhood. Each citizen takes reasonable care to ensure the safety of their home through the use of keys, locks on both windows and doors and an alarm system. The same applies to "peripheral" equipment such as an automobile. Coded number schemes, keys, alarms and locking anti-theft devices such as "The Club" only *help* ensure the safety of their possession. The common notion in New York is "if they really want to get in and they have the right equipment, there is nothing I can do to prevent it, but I can make it much more difficult." This analogy serves to make the point that there is merit in the notion of "virtual communities," with access to other virtual communities. San Francisco's Whole Earth 'Lectronic Link (WELL) is the most prominent example of virtual communities. This network is connected to Internet and protected by a gate which will not open without a password or a credit card. A similar system is being built on the east coast which offers free accounts to women in an effort to balance the "population" and provide a "civilizing force." [9]

Users need to become cognizant of what is normal and abnormal with their computer operations. This may require the knowledge of the equipment specifications, but this is a small investment compared to the cost of putting out the fire once it has been lit.

Encryption: As communication moves to wireless mediums, the only way to keep information private is encryption. Passwords and physical restriction to the environment are not as effective. There are two types of encryption, that which is implemented in hardware and that which is implemented in software. Hardware is able to keep up with today's transmission speeds, but some may be too cost prohibitive or space prohibitive for set-top boxes or cellular phones. Software encryption may not be able to keep up with transmission speed available today. Just as citizens must feel they are reasonably safe to leave their homes, they must also feel safe to venture out onto the Information Superhighway. They must feel that their data is protected unless they authorize the release. This is a familiar notion similar to authorization of medical records and credit information in use today. Data Encryption Standard (DES), the encryption technology presently available in the United States has been re-certified by the National Institute of Standards and Technology for another five years. Re-certification could be dangerous considering that today's computers may soon be able to break these codes. This leads to another problem which faces law enforcement. With the effort to ensure data security, law enforcement needs to be able to deal with uncrackable encryption used by organized crime, drug cartels, and money laundering schemes. The Clipper Chip, proposed by the U.S. government, provides a back-door for authorized wire-tapping. This has met with a plethora of controversy, as the public does not feel comfortable with a chip in their electronic equipment which would allow the government to eavesdrop on their private lives. While this is too reminiscent of George Orwell's _1984_ for most people's tastes, it is not much different from what is already in place today. The government already has the power to tap private phone conversations, albeit with a court order, and the power to search a citizen's home. Regardless of government's intentions to use the Clipper Chip and outlaw stray encryptology, it is highly unlikely that criminals would utilize a technology that would allow government to entrap them (1)

Firewalls: A screened, intelligent gateway to guard access to private networks while allowing controlled access to Internet is available from Digital Equipment Corporation. These devices are designed to protect a company's computing resources from Internet break-ins.(17) Great Circle Associates in California has built a World Wide Web (WWW) service for Internet firewalls. Their services include a list of firewall vendors, a list of Frequently Asked Questions (FAQ's) with answers, and archives of the mailing list. To reach this service in the WWW, the user points their browser to http://www.greatcircle. com/fire walls. (15)

A recent break-in at General Electric Co. may give evidence that firewall security is still a long way from perfect. Computer hackers broke through GE's firewalls gaining access to proprietary information. While no damage to the data was found, GE was forced to shut-down Internet access for four days. It would seem that this incident would force GE to abandon the present security measures or re-think their position regarding commerce on the Internet. Neither has occurred, and GE is currently back on-line with revamped firewalls. They view potential security violations as simply the inherent risk of doing business via the Internet.

Few aspects of the Internet are untouched by security concerns. Server software to the WWW has recently come under scrutiny when it was discovered that there was a glitch that opens the door for a Worm attack. This destructive automated program could systematically destroy "home pages" or sites that are set up by businesses on the Web. Mosaic, a popular Web server software developed by the University of Illinois's National Center for Supercomputer Applications, has been discovered to allow a computer to run a command string of unlimited length. This allows hackers to tack on destructive commands to legitimate command strings which a computer will accept. When informed of the problem, the center immediately developed a "patch" to cover the oversight which will limit the length of the command string that a computer will accept.(2)

Due to the excessive publicity that security problems receive, businesses which are active on the Internet are justifiably concerned. Data from an *Information Week*/Ernst & Young survey of 1,200 executives reveal that 82.9% rank their present data security concerns related to unauthorized access from external sources as "important" to "extremely important." Of this same group, only 37.1% employ firewalls to protect data from external access.(10) This poses the question of how good are firewalls if, even though security was important, executives did not employ them in their security measures.

Security issues and dangers are well documented in the literature. Computer security firms in the industry fundamentally agree on steps to be taken that ensure breaches are kept to a minimum and system integrity is maintained. Newspapers, trade journals, and magazines report on numerous examples of computer security infringement. With all of this publicity and expertise, why are there still endless reports of successful hackers? The largest obstacles to a secure computing environment are cited as lack of support from top management, lack of personnel dedicated to security, and money. An even greater obstacle lies with the user. Computer end-users often feel uncomfortable or outright hostile towards the security measures included in their daily interactions with the system. Employee access verification, while at times seen as a bother and a waste of time, can often be frustrating and confusing to employees who are required to memorize multiple passwords. The tighter the security becomes, the more people circumvent the influence of the system by utilizing obvious passwords, or writing them in a visible or accessible location.

Unfortunately, corporations do not seem to learn from the costly mistakes of their counterparts who have lost money and valuable data to hackers. A new breed of hackers, called "Crackers," are combining hacking and criminal activity. They are not in it for the "thrill," or to satisfy a desire to "beat the computer." Crackers are in the business to steal money, proprietary information and other valuable data from unsuspecting corporations. Top management should feel compelled to view data security as an investment in the future of the company, and not just as an added cost. The development of a dedicated security staff is imperative to the protection of a corporation's computer system. Justification of this expenditure should remain valid even in tough economic times. With the increase of commerce taking place on the Information Superhighway, secure transmission will quickly become vital to the survival of the corporation.[5]

Viruses: No discussion on the security of the Internet would be complete without a section on viruses. It is very difficult to create a single group profile of a typical computer hacker. By staying invisible at the end of an untraceable phone line or by working their way through numerous sites, they are often difficult to trace. The notion of adolescents with a new-found sense of potency form a very clear mental picture of potential perpetrators in the minds of those who attempt to develop a profile. They are young computer hackers with an incredible amount of technological power and time to kill, or they may be disgruntled employees bent on paying back a corporation for imagined or real slights. "The Dark Avenger," believed to be from Bulgaria, states that "the American government can stop me from going to the U.S., but they can't stop my virus." His contribution to the virus world isn't really a virus at all, it is what he calls a "Mutation Engine." This allows viruses to change their appearance as they spread, which makes them difficult to find. An independent researcher finally tracked him down and found him to be uncharacteristically shy. The researcher claims he told her that computers are so expensive in Bulgaria that most common people do not have access to them. Dark Avenger claimed that he was not aware that there would be any consequences of his actions. He stated that he does not hurt people, just data, and that no one would be infected if people avoided pirated software.

In the spirit of an underground covert world, paranoia reigns supreme. Many people believe it is the virus researchers themselves who are creating the viruses. It is claimed that they are creating their own market by making viruses and then selling the preventative tools.[6] In reality, a new type of respect is emerging between those developing the viruses and those trained to prevent their attack. Hackers, by virtue of their continuous attack on the computer systems of the world, provide virus researchers with working tools to refine security measures. With each instance of unauthorized invasion, computer security specialists are presented with the opportunity to close previously unnoticed loopholes. It is a race, albeit an incredibly expensive one, and a small debt of gratitude may be offered to those who call attention to a system's inherent weakness.[4]

PC Computing's September, 1994 issue provides ten tips to avoid computer viruses:

1. *Use anti-virus software that combines scanning, checksum, and monitoring facilities.*
2. *Update your scanning software regularly to make sure it can find newly unleashed viruses.*
3. *Don't use pirated software - you don't know where it's been.*
4. *Don't move copies of executable files from one computer to another; always install from the distribution disk.*
5. *Don't boot from a floppy disk of unknown origin; perform a virus scan before using files from such a disk.*
6. *Treat executable files downloaded from [computer bulletin boards] with suspicion; scan the programs before use.*
7. *If your system is part of a network, use passwords and other security measures to block unauthorized access.*
8. *Don't use an obvious password for your account and don't use the same password on multiple systems.*
9. *Back up your data files regularly, and rotate the backup disks so that you have copies of files on different disks going back several weeks. Keep backups of your applications disks, [also].*
10. *If your system begins to act strangely, if program files behave in an unexpected way or if a file's length or "last saved" date changes unexpectedly, assume you have a virus and perform an aggressive scan. Have a plan in place for notifying users of a possible virus attack.*

Conclusion

The Information Superhighway, with all of its wonders, potential enhancements and problems, is a forming technology. As is the case with new technologies (e.g., the telephone), a mix of public and private control is necessary. Private industry does not have a central body with the authority to exercise control over development issues -- only government has this capability. Government has the right to decree what is meant by free speech or to specify what law would best serve to protect all citizens.

Controversy is not a negative for it proves that Americans, the Government and private industry care about the direction of this phenomenon. Reasonable care and control, from the private user to industry to the government, are essential to ensure the privacy and direction of this emerging technology. With all parties in a synergistic effort, a workable solution can be found just as it has been with other technologies. In an issue as large as this, it is impossible to please all parties. A partnership which employs the strength of private industry with that of government, may provide the best solution possible.

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Assessment of the World Wide Web as a Teaching Tool

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ABSTRACT

Over the past few years, the Internet and the World Wide Web have gained increasing attention. It can be expected that Internet usage and Web navigation skills will become mandatory for students graduating and entering the work force. Faculty and staff in universities have started developing their own skills, and must now transfer this knowledge to students. This paper discusses and evaluates how Web resources have been used in two introduction to data communications classes. A preliminary study suggests that students perceive that practical assignments on Web resources help enhance their learning of course material and global networking in general. Conversely, they feel that while electronic mail knowledge is a must to enter the work force, Web knowledge is yet to be a mandatory skill.

INTRODUCTION

Information resources on the Internet have been available to computer gurus, educators, and researchers for more than two decades. In the past two years, interest and usage of these resources have increased dramatically. The popular press and the publishing industry have jumped on this bandwagon with magazines, books, and other materials filled with news and guidance on how to make use of the wealth of information available on what is now called the "World Wide Web" ("WWW" or "Web" for short).

The population of Web users was estimated at over 20 million at the end of 1993, and has since been increasing by more than 100% per year (Addyman, 1994). Web users include executives, professionals, and others from all industries, hobbyists, special interest groups, families, government, and non-profit organizations. The proliferation of interest in, and the development of web resources by and for mainstream America means that the knowledge required to effectively navigate and use web resources will become an expected skill for graduating students in a near future. Clearly, the basic set of technological skills expected of students entering the job market has evolved over past decades from typing, to the use of personal productivity tools like word processing, spreadsheets, and databases. Expected skills also include now that of computer networking. If usage trends are any indicators, students will be expected by future employers to have developed proficiency in accessing and using Web resources. Two questions motivated us towards doing this research project. First, how can educators help students develop their Web skills? Second, can and does the use of virtual learning environments, such as the Web, enhance students' learning in the classroom?

In schools around the country, faculty and staff have begun scrambling to learn and develop their own Web skills. They have begun to incorporate the use of Web resources into their course curricula. As with the development and use of any new type of instructional materials, it is important that educators also begin to assess the effectiveness of these electronic tools in supporting and enhancing students' learning. This paper reports on a preliminary effort to assess the use of Web resources on student learning, motivation, and interest. The purpose of this paper is threefold. First, we use our own and colleagues' experiences with the Web to discuss ways that electronic resources on Internet can be used to supplement and enhance traditional classroom instruction. Second, we offer a preliminary analysis of both instructors' and students' evaluations of the effectiveness of these tools based on selected criteria. Third, we conclude with a discussion of potential benefits, inherent costs, and ethical issues of using Web tools in the classroom.

ENHANCING THE LEARNING PROCESS IN CLASSROOM ENVIRONMENTS

As an educational tool, there are at least two ways that Web resources can enhance learning in the traditional classroom environment. First, obtaining electronic information on the Web requires students to interact with the technology and information that are presented. Students take an active part in the learning process by controlling both the content and format of the information presented on the screen. They may work through a nested decision process using icons, text, images, or database search engines to move through databases of information, or to establish a link to different servers around the world. The active participation of students through usage of the Web is similar to other traditional active learning techniques such as the case study method, where students must "control" the content and format of the information presented during class (Johnson et al, 1991; Eble, 1988; Beidler, 1986).

Second, using Web resources can also enhance learning through the use of multiple media for information presentation (integration of text, graphics, audio and video). In a comment on how children learn, educator Howard Gardner suggested that children require "multiple entry points" for learning, because they "don't all learn in the same way; they don't all find the same things interesting" (Gardner, 1993). Gardner (1993) has also done extensive research demonstrating that there may be as many as seven different kinds of intelligence: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal. Traditional reading sources of information use only linguistic intelligence, while learning through multiple media allows students to process information through multiple intelligences.

The notion of learning through multiple senses did not begin with multi-media technologies. Memory researchers have known for a long time that the more senses we incorporate into the learning process, the more fully we retain information. There are many popular books available teaching people how to incorporate multiple senses into the learning process through the use of imaginary, vocal, and visual techniques (Hermann, 1991; Buzan,1991; Minninger, 1984; Restak, 1988). What is revolutionary is the incorporation of interactivity and multiple media into classroom based instructional environments.

INCORPORATING WEB RESOURCES INTO THE CURRICULUM: THE EXAMPLE OF DATA COMMUNICATIONS

Both authors are involved in teaching introductory data communications courses at two different universities on the East Coast of the United States. One school (school "A") is in southwest Florida, the other (school "B") is an urban school in New York City. After several years of traditional lecture formats, we both made a transition to using the Internet and incorporating Web resources as educational tools to supplement and enhance the learning of data communications concepts in our classrooms. Based on our experiences, these are some of the ways that Internet and Web resources can be incorporated into course curricula. The initial preliminary studies reported here were conducted at School A. Further research is being conducted at both schools.

Facilities at School A include several open personal computer labs with Internet access. The Web can be accessed on some of the available stations which have Windows and Netscape software. It can also be accessed from one of the UNIX workstations with Mosaic software. While many workstations are available to students, the labs tend to have high occupancy and wait time during peak periods. All students can also connect to the university if they own a personal computer and a modem. Speeds available for remote connections range from 2400 to 28400 bps. Students accessing the Web remotely can use a text only browser (Lynx) on their UNIX account or acquire a slip/PPP that allows them to use graphical browsers. All students majoring in Information Systems have the possibility of requesting a UNIX account.

INTERNET AND THE WORLD WIDE WEB

There is almost an infinite variety of resources available on the Internet. One suggested categorization of these resources (Addyman, 1994) is: 1) information technology tools; 2) human expertise and perspectives; and, 3) information resources. Following is a brief summary of how some of these Internet and Web resources could be used to enhance students' learning experience in a classroom.

Information Technology Software Tools

Using file transfer software and a modem, many types of information technology software tools can be downloaded for installation and use on students' computers. Known as "shareware", some of the available programs loaded in public directories at server sites around the world include:

* Utility programs (Examples: anti-viruses, screen savers, add-ons to Windows; software allowing users to view video clips, hear sound bites or view graphical images);

* Application programs (Examples: electronic mail, personal productivity software, graphical user interfaces to other programs, CASE tools);

* Games;

* Communication programs (Examples: file transfer and terminal emulation programs, internet protocol drivers); and,

* Tutorials and online handbooks.

In a course such as business data communications, students are taught the fundamentals of networking, including data communications media, local area networks, wide area networks, and network management. By working with students to obtain access to the Web through the campus networks or through dial-up access from home, many of the fundamental concepts of data communications can be demonstrated, including client/server architectures, internet protocols, message handling services, file transfer, and terminal emulation.

Human Expertise and Perspectives

The virtual learning environment of the Internet and the Web is best demonstrated through the sharing of expertise and perspectives across time and space. Geographical location of the participants in a virtual learning environment has become irrelevant, as students can share information and insights with others around the world. With respect to the "boundaries" of time, there are two communication modes whereby expertise and information can be shared on the Web, synchronous and asynchronous communication.

In synchronous ("real time") communication, students can participate in online discussion groups known as chat sessions. This is the electronic equivalent to a telephone conference call. Dialogue typed in by one user is visible on all users' screen. We were not able to establish student chat sessions for the semesters reported here.

For asynchronous communication, there are two ways that students can communicate with others: through a newsgroup subscription, and by using electronic mail ("email"). A newsgroup subscription is similar to a magazine subscription, except that all participants who subscribe to the newsgroup can also become contributors by posting messages and responding to messages. A newsgroup is like an electronic bulletin board system. A newsgroup can be created for each class, and students can post notes and conduct discussions on topics of interest to the class. In order to set up a newsgroup, ownership privileges, and an internet address have to be set up so that students can all access a particular file on the server. We decided not to set one up this semester since security and ownership issues have to be addressed first, but plan to do this in future semesters.

The easiest and most useful internet resource, from both the students and teachers' perspective, has been the use of email. At both schools, students were provided with email accounts and encouraged to use email to discuss problems or questions with the teacher, share information on group projects with other students, or for general communication purposes. In order to get them past the initial fear of the system (e.g., "will my mail get there?" or "will I be able to use the system?"), the first assignment given at the beginning of the semester requires students to sign on, view an email message from the instructor and to respond by selecting the "reply" function. After this initial step, all assignments in school A are sent via email and students are required to turn them in using the same medium. In school B, students write to each other about their team projects or simply to communicate, since many students live in different area codes and save money on telephone calls by using email. Also in class B, many students are from other countries, and use their internet addresses to communicate with friends and family overseas.

Using email has many potential benefits. On the one hand it is an easy way to get students on the computer. It also helps them think about telecommunications, especially if they use their computers from home to connect to the university. Since they start using email early in the semester, we are able to refer back to their experiences with email to explain concepts in data communications: modems, transmission concepts, coding schemes, data link protocols, security and data integrity issues. Using email also helps students visualize the underlying architecture of the Internet. One way to do this is to select two or three different email message headers (listing all the address nodes through which the message passed on its way from sender to receiver) to see how messages progress through different nodes that are part of the global network known as Internet.

Information Resources

The term World Wide Web (WWW) most aptly describes the efficient graphical user interfaces available for accessing information resources on the Internet (Powell, 1994). The efficiency of accessing information via the Web is in great part due to the way that the information in two different files can be linked using hypertext transport protocols (http). Hypertext is generated through coded commands embedded in the text and called hypertext markup language (HTML). Using a Web browser, one can view a highlighted section of text that, when selected with the cursor or mouse, will link the user to a file that may be located on another computer (server) in any part of the world. Using Web browsers, a student can navigate through a globally distributed information storehouse by following simple pointers from one hypermedia document to another (Chapin, 1995; Powell, 1994).

Most students are surprised and delighted with the vast array of entertaining and informative information accessible using graphical Web browsers like Mosaic and Netscape, or Lynx (text only). Incorporating the Web into course curriculum can be accomplished in several stages.

Introductory stage: navigation

Students can be provided with some interesting Web pages to begin their browsing. They quickly grasp the navigational possibilities using hypertext links, and they begin exploring the Web on their own. A good way to generate enthusiasm and share information is to have students report back to the class on their favorite Web page locations. Page locations are known as Universal Resource Locators (URLs), and are generally in the format
http://www.some.address.domain/directory/subdirectory/page.html.

Another interesting Web browsing activity is to create an online treasure hunt where students must find answers on the Web. Learning through Web navigation is revolutionary in the sense that, rather than the teacher shoving pre-structured knowledge in a fixed format at the student, the student is interactively designing his/her own knowledge structure. The process of learning is under the student's control, not the teacher's. At this introductory stage, the goal is to have the students discover, on their own, the global nature of the information repository on the Web. Once they recognize its potential, the next step is to investigate a particular topic or problem using the resources available on the Web.

Intermediate stage: course pedagogy

The second stage of potential usage of the Web is for dissemination of pedagogical materials. The instructor can provide all information related to the course via a Web page, including the syllabus, class notes, notices, assignments, cases, tutorials, and can include a "mailto" function which allows students to generate an email message back to the instructor. An additional benefit of developing course materials using hypertext links is that an instructor can link tutorials and case studies developed by others onto the course page. Once the students grasp the nature of their virtual learning environment, the third and most advanced stage of Web involvement is to help them develop their own pages.

Advanced stage: Web development

Students who are comfortable with the first two stages are ready to begin designing their own Web pages. There are many tutorials, manuals, and other documentation available on the Web for helping students to design their pages. Feature of a typical Web page include the use of icons (graphical symbols), digitized photos, and other graphical symbols. Using HTML, students learn how to embed links to graphical images within their text, and if time and equipment permits, they can use scanners to digitize their own logos, icons, and images.

THE WEB SURVEY

As an attempt to investigate the impacts of the use of these resources, an anonymous questionnaire was given to two classes of students taking a business data communications class. The first class studied was in a spring semester while the second one was in the summer. Students were undergraduates completing their last year of their bachelor of business degrees in Information

Systems. The course was an elective which could count towards a concentration in distributed information systems. Table 1 provides some general demographic information on the two classes.

Table 1. Demographic information for A1 & A2 Classes

	Class A1 (spring)	Class A2 (summer)
Number of Students:	31	21
Females	10 (32%)	9 (43%)
Males	21 (68%)	12 (57%)
Age of Students:		
Average	25	31
Minimum	21	22
Maximum	31	45
Highest Degree Completed:		
High School	27 (87%)	19 (90%)
Bachelor	4 (13%)	2 (10%)
Personal Computer at Home:		
YES	23 (74%)	18 (86%)
NO	8 (26%)	3 (14%)

The objectives of the questionnaire were: to evaluate the extent of students' use of the Internet, the Web and related resources; to obtain their opinion of the educational value of those resources; to investigate their motivation to keep up their learning via the Web and the Internet after their current course; and, to get their overall satisfaction or feeling about how much their experience with the Internet and the Web resources enhanced their learning over the semester. Space was also provided for additional comments and suggestions. The questionnaire contained more questions than what is reported here.

Results

The first set of questions tried to evaluate the relative usage and knowledge of the resources before and after taking the course. Results are presented in Table 2. It can be seen that both the knowledge and the usage of all the resources increased after the course, sometimes significantly. Noticeably, the increased was larger for Web resources than for electronic mail for both classes. This is to be expected given that electronic mail has been around a long time and most people are familiar with the technology. On the other hand, many students commented that it was the first time they had heard of the Web while attending these classes. Another interesting result is that while many students did consider they had no knowledge or usage at all of the resources before the class, all felt they had gained some experience in using the resources and some understanding of them after the class.

Since the increased usage and knowledge could have simply been the results of taking the courses, students were also asked to provide their impression of how the hands-on assignments on the Web and electronic mail helped in their increased knowledge and usage. On average, students felt that the electronic mail and Web practical assignments did help them understand course concepts. These results are presented in Table 3.

Table 2. Before and After Comparison of Knowledge and Usage for A1 & A2 Classes
(Scale: 1=not at all to 7=very much)

	Class A1				Class A2			
	Mean	Std	Min	Max	Mean	Std	Min	Max
INTERNET								
Knowledge before class	3.45	1.74	1	7	4.00	1.66	1	7
Knowledge after class	5.45	1.21	3	7	5.38	1.05	3	7
EMAIL								
Knowledge before class	4.77	1.81	1	7	5.00	1.90	1	7
Knowledge after class	6.23	0.71	5	7	5.90	1.01	4	7
Usage before class	4.35	2.18	1	7	4.62	2.01	1	7
Usage after class	6.16	0.99	3	7	5.81	1.18	3	7
WEB								
Knowledge before class	2.90	1.75	1	7	3.67	1.75	1	7
Knowledge after class	5.19	1.28	3	7	5.19	1.30	3	7
Usage before class	2.35	1.73	1	6	2.90	1.92	1	7
Usage after class	5.13	1.39	2	7	4.76	1.63	1	7

Table 3. Students' Perceptions
(Scale: 1=confused me; 2=did not help; 3=somewhat helped; 4=tremendously helped)

How they helped to understand course	A1 Class				A2 Class			
	Mean	Std	Min	Max	Mean	Std	Min	Max
EMAIL Assignments	2.94	0.80	2	4	3.29	0.70	2	4
WEB Assignments	3.10	0.64	2	4	3.14	0.71	2	4

In order to verify how students ranked the usefulness of the resources, we asked them how much they thought electronic mail and Web knowledge were required in today's job market. While they clearly indicated that electronic mail was a must, the Web had not gained the same status (Table 4). On the other hand, most students (94% for Class A1 and 86% for Class A2) said they would like to continue using the Web after the course was finished. Reasons for this included information, research, fun, work, daily news, entertainment, profit, communication, leisure, and more.

Table 4. Necessity of Skill on the Market
(Scale: 1=not at all to 7=very much)

	A1 Class Mean	Std	Min	Max	A2 Class Mean	Std	Min	Max
Email	6.26	0.95	3	7	6.48	0.73	5	7
Web	4.00	1.63	1	7	4.67	1.61	2	7

DISCUSSION

This paper discussed potential uses of the Internet and Web global distributed information repositories as tools for enhancing the traditional classroom learning environment. Both authors feel that there are many benefits to using these vast resources. Students seem to confirm the authors' perceptions, and reacted very positively to the experience. Preliminary results from our studies tend to indicate that students feel their understanding of data communications was improved by the practical usage of the resources. In their comments, many students suggested greater use of practical assignments. However, there are some important issues that educators should consider if they plan to incorporate Internet or Web use into their curriculum.

Startup costs

There are startup requirements for using Internet and Web resources. At a minimum, students must have access to an internet node with an Internet Protocol (IP) address from which they can access the Internet. At most schools, this is accomplished through a mainframe based host computer, or a UNIX based server on a local area network (LAN). Students need to have a computer account that allows them to have host access for email, and the ability to access facilities on the host for file transfer, Web browsing, and other functions. Alternatively, many small, medium, and large Internet service providers operate around the country. Dial-up user accounts can cost as little as $10/month. If students want to design their own Web pages, then they need appropriate storage space on a server that is always running where they can upload their pages.

Information Integrity

One of the main issues surrounding the distributed nature of the Web is that information is maintained by thousands of individuals operating on their own initiative. Students accessing information on the Web may assume that if it's on the Web, then it must be true or valid. Since anyone with a server and an IP address can design and put up a Web page, there is always the possibility that information will inadvertently or deliberately be false, misleading, inaccurate, or outdated.

Another serious concern is the nature of intellectual property. Since there is so much information on the Web, and it is so easy to download information, students may not understand that copyright violations can occur if they download a copyrighted image to embed in their work. Or they may not understand that if they download information to include in a paper or assignment, they should carefully track and cite all references to that information. There are also moral issues associated with Web use, i.e., on the availability of pornographic, racist, or other socially objectionable material on the Web. When students get to the stage of Web development, this is a good time to discuss all the ethical, legal, social, and political issues involved in this new frontier. As in the Gold Rush days in the wild west, the Web represents a "gold mine" of information, and the gold rush is on. Amid this flurry of activity, there are actually very few standards (legal or moral) governing the behavior of the participants. And similar to the days of the wild west, the new frontier is populated by many rugged individualists who would like to avoid all external governance of behavior, but rely instead on individual conscience and personal preferences.

CONCLUSION

The Internet has the potential of reducing gaps in society by providing equal access to information in all countries, in all types of organizations and to people with different levels of technology knowledge (Ahrens, 1993). It already provides more than the basic services mentioned in the article. It is now used for radio broadcasting at a university (Petrozzello, 1995); international conferences (Krieger, 1994) and a host of commercial applications (Chapin, 1995; Semich, 1995).

Educators need to be aware of the resources available to them. They also need, however, to understand the impacts of these technologies on students' learning. We have attempted here to provide an initial evaluation of the Internet and the World Wide Web as tools to enhance traditional classroom environment. We believe that there are two main reasons for using the resources. First, we strongly feel and have attempted to show in this paper that learning is enhanced by the use of these resources. Second, students need to be aware of the existence of these resources and must be able to efficiently use them, in order to face today's dynamic business world.

ACKNOWLEDGMENTS

The authors would like to extend their gratitude to Mary Burns for her support.

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Internet with Encryption for Traffic Control in Thailand

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ABSTRACT

The city of Bangkok, Thailand is notorious for traffic jams. As an example, at the beginning of the Thai New Year in 1995, the traffic condition from the city to the airport was so bad that it took 5-6 hours to travel the 20 kilometers distance. This paper presents a solution for traffic control by use of the Internet network to make it possible to learn of the traffic condition at each sub-district of Bangkok conveniently; to make it possible to display the traffic conditions in both text and graphic for the entire city of Bangkok; to make it possible to up-date the conditions as often as required; to make it possible to learn of the traffic jam at the time it is starting so that action can be taken to stop it before it develop into a serious problem; and to make it possible to coordinate the activities of traffic control and command among several units such as Office of the Prime Minister, Traffic Police Department, Bangkok Metropolitan Administration, and Traffic Information Radio Station. At times, the authorities in charge need to communicate in secret to arrange the traffic to handle special conditions such as to accommodate VIP and to create traffic jam as road block to arrest potential criminals. Therefore, this paper also presents encryption algorithms for the purpose of secret communication in traffic control in Thailand.

1. INTRODUCTION

Bangkok, the capital of Thailand, is the residence of more than 6 million people and a few more million travel in and out of the city from other areas of the country. The traffic condition is getting worse and worse. As an example, at the Thai new year in 1995, a lot of people tried to travel to the airport about 20 kilometers from the center of the city. The road to the airport is also the main road to travel to the North where big new year celebration is organized. The traffic jam at that time was so bad that it took 5-6 hours to travel the 20 kilometers distance. Some actions are needed to remedy the traffic jam. The authors were asked by the Office of the Prime Minister to suggest a solution and they suggested the use of the Internet computer network.

This paper presents the use of the Internet [1] for traffic control in Thailand as well as encryption algorithms for the traffic authority to use to make secret communication when it is necessary and desirable.

2. Purposes of Internet for Traffic Control

There are 4 main purposes as follows:

(1) To make it possible to learn of the traffic condition at each sub-district of Bangkok conveniently.

(2) To make it possible to display the traffic conditions in both text and graphic for the entire city of Bangkok and possible to up-date the conditions as often as required.

(3) To learn of the traffic jam at the time it is starting so that action can be taken to stop it before it develop into a serious problem.

(4) To make it possible to coordinate the activities of traffic control and command among several units such as Office of the Prime Minister, Traffic Police Department, Bangkok Metropolitan Administration, and Traffic Information Radio Station.

3. Organizations Concerned

Four organizations are concerned. They are:

- Office of Land Transportation Control, Office of the Prime Minister
- Traffic Police Unit, Police Department
- The Internet Institute of Assumption University
- KSC Commercial Internet Co., Ltd. which is a joint venture with the Communications Authority of Thailand.

The four organizations interact in the following manners:

(1) The Network Operation Center (NOC) of the Internet Institute of Assumption University and KSC Commercial Internet Co., Ltd. is used as the central point for the traffic control system because this NOC has all the required hardware, software, telecommunication and personnel readily available.

(2) Internet nodes are established at Office of Land Transportation Control, Office of the Prime Minister and at the Traffic Police Unit, Police Department. Each unit has a SunSparc Classic with 32 Mb of main memory and 1 Gb of disk.

(3) Each sub-unit of traffic control authorities such as North Bangkok Command, South Bangkok Command, and Thonburi Command has a 486 PC connected to the Internet system via 14.4 Kbps modem.

(4) For other concerned units such as traffic control radio station, television stations, police stations, etc., some of them established Internet nodes while others use micro computers to connect via modem.

(5) Any other parties, such as a citizen, may use his micro computer to connect to the system via modem

4. Software and Hardware

The initial set of software used are free of charge and available from the Internet. Examples of those software are:

- HTTP or Hyper Text Transfer Protocol to look at graphic and text
- HTML or Hyper Text Markup Language to set up and modified graphic and text
- NetScape or Mosaic

For hardware, the followings are used:

4.1 At the Traffic Control Office.

To connect as an Internet node with the followings:

- The hardware is a SunSparc Classic with 32 Mb main memory and 1 Gb hard disk

- Leased line from the Telephone Organization of Thailand or DataNet Data Over Voice Service connecting the office to NOC
- Internet connection through KSC Commercial Internet Co., Ltd.
- Projector to project the image from the computer onto a big screen
- Scanner to enter the map into the computer

4.2 At Other Points.

To connect as a terminal, the followings are needed:

- Micro computer
- A modem
- A telephone line
- Connection service through KSC Commercial Internet Co., Ltd.

5. Benefits in Using Internet for Traffic Control

The following benefits are realized.

- Implementation can be done swiftly.
- Extensively tested system of the Internet guarantee operability and users' acceptance.
- Both text and color graphic can be used.
- Easy to expand.
- Economical
- Open to all parties concerned
- Land marks such as photograph of monument and building can be included in the map for ease of recognition.

6. Encryption

At times, the traffic control authorities may need to communicate in secret. They may have to handle special conditions such as to accommodate VIP and to create traffic jam as road block to arrest potential criminals. Therefore, encryption algorithms are presented here [2,3,4,5].

There are many existing encryption algorithms. However, they can be mainly classified into one of the two basic types, namely, substitution cryptosystem and transposition cryptosystem. A few classical methods will be applied to traffic control messages.

The first example is the Caesar Cipher with the formula

$$c_i = E(p_i) = p_i + 3$$

Where c_i stands for the i-th character of the ciphertext
p_i stands for the i-th character of the plaintext
E stands for the Encryption function

The total number of English character are 26, usually counted as 0, 1, 2, 3, ... , 25. The plaintext is usually represented in capital letters and the ciphertext in lower case letters. A full translation chart of Caesar cipher is:

Plaintext:	A B	C D	E F	G H	I J
Ciphertext:	d e	f g	h i	j k	l m
Plaintext:	K L	M N	O P	Q R	S T
Ciphertext:	n o	p q	r s	t u	v w
Plaintext:	U V	W X	Y Z		
Ciphertext:	x y	z a	b c		

Many of the traffic control messages also include numbers such as telephone numbers, and time. Therefore, encryption algorithms are needed to encrypt the numbers and the authors would like to propose a few as shown in Table 1.

Table 1. Proposed Encryption Algorithms for Numbers

Code	Algorithms	Sample Plaintext	Sample Ciphertext
1	Reverse	7191583	3851917
2	Add 1 to every digit	7191583	8202694
3	Add 2 to every digit	7191583	9313795
4	Subtract 1 to every digit	7191583	6080472
5	Subtract 2 to every digit	7191583	5979361
6	1, 3, 5, ..., 2, 4, 6, ...	7191583	7953118
7	2, 4, 6, ..., 1, 3, 5, ...	7191583	1187953

Table 2. SampleTraffic Control Message Encrypted with Caesar Cipher and the Proposed Algorithms for Numbers

Plaintext	Ciphertext
Please call office 7191584	sohdvh fdoo riilfh 8202695(2)
Call 3004543	fdoo 3454003 (1)
Clear Intersection 2	fohbu lqwhuvhfwlrq 5 (3)
Block Intersection 3	eorfn lqwhuvhfwlrq 4 (2)

Table 3. Sample Columnar Transposition

C	L	E	A	R
I	N	T	E	R
S	E	C	T	I
O	N	2	B	A
N	G	K	O	K

The code may be transmitted by the sender to the receiver to indicate which algorithm is used. Alternately, an agreement may be entered between the sender and the receiver such as that Algorithm numbered "I" is used on the "I th" day of the week.

Sample results of encryption with Caesar Cryptosystem and the proposed algorithms for numbers are shown in Table 2. From Table 2 above, the number "I" in parenthesis at the end of the numbers in the ciphertext indicates that Algorithm I in Table 1 is used.

The second algorithm to be used here is the popular transposition cryptosystem called Columnar Transposition. As an example, consider the 5-columnar transposition with the proposed algorithms in Table 1. The plaintext "CLEAR INTERSECTION 2" is entered into five columns of five rows each with the phrase "BANGKOK" used to fill in the blank as shown in Table 3.

Table 4. Sample Traffic Control Message Encrypted with Five Columnar Cipher

Plaintext	Ciphertext
CLEAR INTERSECTION 2	cison lneng etc2k aetbo rriak
CALL 3004543 ASAP	co3vo aoaak l4sno l5aga 34pkn
BLOCK INTERSECTION 3	bison lnenc otc3k cetbo kriak

Table 3 is read down column-by-column, producing the ciphertext:

cison lneng etc2k aetbo rriak

Samples of transposition encryptions are shown in Table 4.

Another encryption algorithm proposed by the authors is based on the concept of Polyalphabetic Ciphers which is an improvement of the simple monoalphabetic technique. The starting point is Caesar Cipher which was modified to be Vigenere cipher by making the keys varies from 0 through 25 rather than staying fixed at 3. Thus, the formula is

$$c_i = p_i + i$$

Vigenere Cipher was further improved by Gilbert Vernam who proposed that the keys be random. Vernam Cipher was supposed to work on binary data rather than letters. The formula may be expressed as

$$c_i = p_i \oplus k_i$$

where

p_i = ith binary digit of plaintext
k_i = ith binary digit of key
c_i = ith binary digit of ciphertext
$\oplus$ = exclusive-or (XOR) operation

Then Joseph Mauborgne proposed another improvement to the Vernam Cipher which yields the ultimate in security, according to the book entitled "Network and Internetwork Security" [5]. He suggested using a random key that was as long as the message and without any repetition. This kind of key is known as a one-time pad and is unbreakable. The ciphertext bears no statistical relationship to the plaintext. However, the modified Vernam Cipher is rarely used because it was difficult for the sender and receiver to be in possession of the same random key.

The authors proposed that the Vernam Cipher is further modified to be used on letters and numbers with any known list of keys such as telephone numbers in the white page telephone book. For example, the sender and the receiver may agree to use Bangkok phone book of a particular year, e.g. 1993 and a particular page, e.g. page 39.

The authors also proposed the use of variable and multialphabetical method in the sense that each character in the plaintext is replaced by multicharacters to become the ciphertext. In particular, a character in the plaintext is replaced by a name which may be taken from the lists agreed upon by both the sender and the receiver.

Suppose the random numbers are taken from telephone numbers on a certain page of a certain phone book, e.g. "7191584 3811306", the plaintext is "ROAD 2" and the list of names as shown in Table 5 which may be taken from many publication such as list of college and

Table 5. List of College and University Names and Numeric Representation

Numeric Representation	Name	Numeric Representation	Name
0	Abilene	13	Balwin
1	Adams	14	Ball
2	Adelphi	15	Baltimore
3	Adrian	16	Barat
4	Agnes	17	Barer
5	Akron	18	Bard
6	Alabama	19	Barnard
7	Alaska	20	Barington
8	Albany	21	Caldwell
9	Alberths	22	California
10	Albion	23	Calvin
11	Babson	24	Canisius
12	Baker	25	Capital

university names from a dictionary, skipping the names that do not start with a noun and skipping repeated names as well as taking only the first ten names for any alphabet.

In order to perform the computation, the decimal digits and letters have to be given numeric values as shown in Table 6., and the parentheses remain unchanged. The encryption is shown in Table7.

The numeric results from the last row of Table 7 are used to look up the name in Table 5. For example, the plaintext " R " with numeric value " 8 " will give the second entry from Table 5 which is "Albany". To make the ciphertext look good, comma is inserted between any two city names and the word "and " inserted before the last city name. The resulting ciphertext for the plaintext "ROAD 2" is :

"Albany, Capital, Barnard, and Ball 7 "

Table 6. Numeric Values of Alphabets

0	1	2	3	4	5	6	7	8	9			
0	1	2	3	4	5	6	7	8	9			

A	B	C	D	E	F	G	H	I	J	K	L	M
10	11	12	13	14	15	16	17	18	19	20	21	22

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
23	24	25	26	27	28	29	30	31	32	33	34	35

Table 7. Sample Encryption

Plaintext	**R**	**O**	**A**	**D**	**2**
Numeric Rep.	27	24	10	13	2
Key	7	1	9	1	5
Sum	34	25	19	14	7
Mod 26	8	25	19	14	7

6. Concluding Remarks

The Internet has been used successfully for traffic control in Thailand. The Internet makes it possible to learn of the traffic condition at each sub-district of Bangkok conveniently; to display the traffic conditions in both text and graphic for the entire city of Bangkok; to up-date the conditions as often as required; to learn of the traffic jam at the time it is starting so that action can be taken to stop it before it develop into a serious problem; and to coordinate the activities of traffic control and command among several units such as Office of the Prime Minister, Traffic Police Department, Bangkok Metropolitan Administration, and Traffic Information Radio Station. Encryption algorithms have also been presented for the authorities in charge to communicate in secret to arrange the traffic to handle special conditions such as to accommodate VIP and to create traffic jam as road block to arrest potential criminals.

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INFORMATION TECHNOLOGY AND MARKETING: CREATING DISTRIBUTION NETWORKS

PANEL SESSION

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The impact of information technology (IT) on marketing has been significant in recent years. In no area is the impact more notable than in building competitive advantage through trade partner networks--alliances between raw materials suppliers, producers, and retailers. These alliances are intended to streamline the flow of materials and finished goods through distribution channels, resulting in higher sales, lower costs, lower inventories, and greater levels of customer service.

For members of a supply network to view themselves as a team is a relatively new concept in channel management, replacing the old adversarial stance formerly taken between distribution partners. This trend became apparent in the early 1980's when automobile manufacturers began implementing just-in-time (JIT) procedures to reduce their stockpiles of inventory and materials, resulting in "partnerships" with suppliers.

The glue that holds the partnerships together is the partners' adoption of information technology, thus marrying IT and marketing in the quest for strategic advantage. This panel session will focus on the four areas that have been identified where IT plays a vital role in successful partnership implementation: shared systems, communication, forecasting and problem solving, and vendor managed inventory. Each area will be explored from both the marketing and IT perspectives.

Experimenting with a Remote Communication Project in an Information Systems Course

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ABSTRACT

University students enrolled in information systems courses (within the business core curriculum) at two midwestern universities, one in Michigan and one in Minnesota, were teamed together to collaborate on a business group decision-making task using electronic mail (email). As participants in this pilot study, students were required to analyze an information systems business case and develop a group recommendation for action based on discussions conducted via email over a two-week time period. This paper reports the experiences of the student teams over this time period, presents key findings of the pilot study, and provides recommendations for similar projects designed to integrate computer-based communication into the classroom as a general instructional resource.

INTRODUCTION

At a time of flattening organizational hierarchies and emerging team-based organizational structures, the ability to communicate with computer-based tools becomes increasingly important (Huber, 1990; Sproull & Kiesler, 1992; Johansen, Sibbet, Benson, Martin, Mittman, & Saffo, 1991). Indeed, organizational communication via computer-based tools is commonplace in business, government, and academia (Sproull & Kiesler, 1992; Hiltz & Turoff, 1993; Comer, 1995; Wild & Winniford, 1993; Krol, 1992). Computer-based communication that includes electronic mail, computer bulletin boards, newsgroups, and computer conferencing serves as a vital medium for discussion and managerial problem solving (Bostrum, Watson, & Kinney, 1992; Hiltz & Turoff, 1993; Kirkpatrick, 1993). Although educators have begun to train students for general computer literacy, the use of computer-based communication as a *pedagogical* tool within information systems education remains, for the most part, largely unexplored (for other disciplines' examples of email usage, see Lowry, Koneman, Osman-Jouchoux, & Wilson, 1994; Shedletsky, 1993; Velayo, 1994; Poling, 1994; Smith, 1994; Harasim, 1993; Wild & Winniford, 1993; Hiltz, 1986). This paper provides a concrete example of incorporating computer-based communication into the classroom as a general instructional resource, rather than as an object of instruction itself.

Integrating electronic mail (email) and other types of computer-based communications tools into the curriculum can provide greater opportunities for students to participate in class discussion, augment limited class time available for student interaction, increase access to faculty, and train students to use the media. As educators, our motivation for undertaking this project as part of a business course that concentrates on the conceptual and theoretical foundations of information systems and technology was three-fold: (1) to provide an active learning experience for students in order to support student integration and understanding of new material; (2) to simulate the characteristics of decision-making and problem-solving for information systems issues in today's business environment; and (3) to provide the students with practice in using written communication skills in the discussion and development of a final group product. Additionally, as researchers in information systems, we were also interested in understanding more about the process of applying information technology to the task of classroom instruction.

Educational research has demonstrated that students involved in active learning experiences tend to learn more effectively than those students engaged in simple, passive learning experiences such as lectures (Angelo, 1993; Cross & Angelo, 1988). The project reported here provided a hands-on case study example of computer-based communication for students to experience while using material presented in the class. Students in information systems core courses are often asked to imagine actual business situations and to conceptualize the information technology that operates to support managerial decision-making and problem-solving. This project provided students with a dynamic, active learning experience in *using* the technology for decision-making and problem-solving, thus making the topics presented in the classroom more concrete.

The class assignment was designed to simulate an unstructured problem involving the technical concept of systems integration. The project required students to manage and adapt the information technology to meet their needs in conducting group discussion and for communicating a final recommendation from each team. As such, this experience mirrors typical, actual business activity in which teams, composed of members from dispersed sites, are required to work together in a decision-making situation (Opper & Fersko-Weiss, 1992; Johansen et al., 1991; Kirkpatrick, 1993). Similarly, the unstructured nature of the task in this project characterizes typical problems that students are likely to face in actual business settings (Laudon & Laudon, 1995; Bazerman, 1994; Huber, 1990).

A key issue raised by many business recruiters is that college graduates require strong communication skills in order to successfully participate in today's business environment (Horner, 1995; Gorgone, Couger, Davis, Feinstein, Kasper & Longnecker, 1994). Further, as computer-based tools such as email become increasingly important to business professionals (Lee, 1994), individuals' ability to express themselves well in writing remains paramount. Our final motivation for this type of project involved the opportunity for students to practice their written communication skills within the medium of email technology. This project required students to introduce themselves, establish a rapport with their remote team members, and conduct group discussion exclusively through written communication via email. Thus, this experience held the potential for providing a valuable learning opportunity to highlight the strengths and weaknesses of students' written communication skills.

This paper reports a pilot project in which students enrolled in information systems courses in two midwestern universities, one in Michigan and the other in Minnesota, collaborated to complete a business decision-making task using email. Four student teams were formed with members from both universities in each group. The group decision-making task required analysis of an information systems business case and development of a group recommendation for action based on discussions conducted via email over a two-week time period. This paper evaluates the experiences of the student teams over this time period, includes key findings from the pilot study, summarizes the study's practical implications, and presents our recommendations for similar future projects.

RESEARCH FRAMEWORK

Because a focus in our study was to understand the process of applying information technology to the task of classroom instruction, we deemed it appropriate to investigate the group processes involved in the students' usage of email to support group interaction. Our overall frame for this study is based on a small group process model (Hackman & Morris, 1975; McGrath, 1984) that permits us to focus on the communicative interaction of group members during group discussions.

This research framework assumes that to understand group interaction we must consider inputs which shape interaction, the nature of the group's interaction processes, and outputs which result from the interaction. Further, with each episode of communication, we must allow for the recursive feedback of intermediate outcomes which shape further interaction processes. Framing the study in this manner allows us to gain a descriptive yet systematic understanding of the experiences of our student groups as they unfolded over time. Figure 1 provides a graphic representation of our high-level model of the small group process interaction.

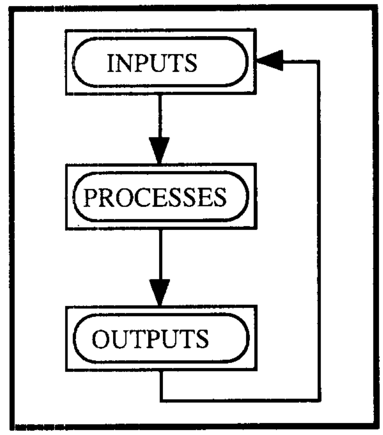

Figure 1. A generic, or high-level, model of the small group decision process interaction (Adapted from McGrath [1984] and Hackman and Morris [1975].)

Although the high-level model was useful for shaping our investigation, it was necessary to enlarge the generic model to focus on the group problem-solving, group discussion, and group learning processes as part of the group interaction process and to look for specific discussion outcomes that might result. Figure 2 depicts the refined model that we applied to our analysis of the student groups' remote communication discussions with email over the period of our study. This focus underscores our goal at this stage of our research of understanding the *processes* of the varying groups' interaction via email. Future research is planned to investigate the influence of varying inputs to the group interaction process and differential outcomes of the interaction process.

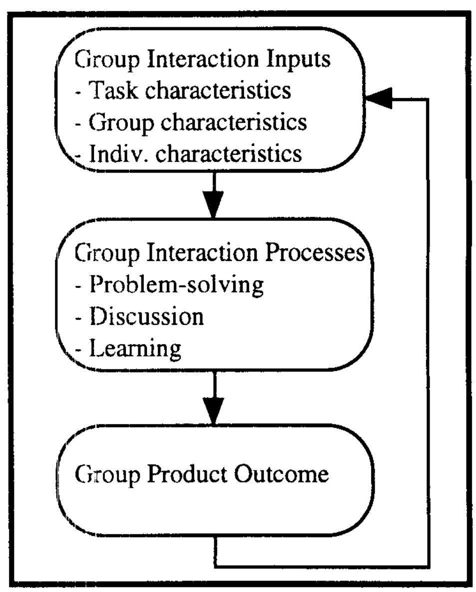

Figure 2. Specific model of the group process interaction applied to the remote communication discussions.

Group Interaction Inputs: This portion of the model is concerned with task characteristics, group characteristics, and individual characteristics. For the purposes of this investigation, these model elements are included at a high-level and will be expanded in further research of this phenomenon (see Brown & Vician, 1995).

Group Problem-Solving Process: This element of the interaction process provided us with information regarding the group's general problem-solving process within the context of computer-based communication. In particular, we were concerned with understanding the steps taken by groups to arrive at a final group decision when the interaction was conducted solely via email.

Group Discussion Process: The group's discussion process is an arena for the group's development of problem-solving and communication strategies necessary to meet the demands of the task. Our emphasis concentrated on understanding the startup activities, the ongoing activities, and the closing activities related to facilitating active communication among members of each group.

Group Learning Process: Our concentration in this area was focused on assessing each group's ability to learn how to apply the computer-based communication technology of email to the group task. We were interested in gaining an awareness of how student groups come to terms with the nuances embedded in the email technology itself as well as each group's socially constructed reality of learning to use the technology to address group task goals.

Group Product Outcome: This portion of the model refers to the final recommendation required of all groups in this assignment. Both the form and the content of the final group product were evaluated as part of our analysis of group outcomes from email discussions.

The expanded research framework provided us with a structure for data analysis and a context within which to report our findings. Additionally, it provided us with a frame for planning future research.

METHODOLOGY

Participants

Thirty-five junior and senior college students enrolled in a core information systems class during fall quarter 1994, at two public midwestern universities, volunteered to participate in this pilot study. Nine students from a Michigan university participated, and twenty-six students from a Minnesota university took part. Course instructors at each university divided their participants into four groups. Each group was instructed that it was to complete the remote computer-based assignment with its counterpart group at the other institution. A typical team consisted of approximately two students from the Michigan university and seven students from the Minnesota university. Students who participated received class credit toward their final course grade. Participants at both universities had used email previously to conduct group discussion regarding course topics as part of their regular class assignments.

Procedures

Group members were provided a business information systems case that required group discussion and task resolution using email exclusively as the communication medium. Specifically, the case involved a hypothetical large midwestern manufacturer of medical devices with two primary centers of operation, one in Michigan and one in Minnesota, with two smaller divisions in other states, each site maintaining its own human resources department. Team members were instructed to think of themselves as members of a combined task force from the two primary sites in Michigan and Minnesota. The task assigned by senior management (course instructors) required that group members study and discuss the issue of integrating the information systems used by the human resources department in each of the company's divisions and prepare a recommendation as to whether these systems should be consolidated. The groups were provided minimal directions but were instructed to discuss via email the technological, organizational, and managerial implications of such a change and to include with its recommendation a summary of the advantages and disadvantages, costs and benefits. In addition, task force members at the Michigan university were provided individuating information about the system currently used at the Michigan site. For the Minnesota university students, additional information was provided about the system currently used at the Minnesota site. Group members at each university were provided the names and email addresses of their counterparts at the other institution. Students were reminded as they began the assignment to introduce themselves to their counterparts on the other campus. Finally, the groups were instructed to include the course instructors at both universities on their email distribution lists. The complete case and set of instructions may be found in the Appendix.

ANALYTIC APPROACH

We employed a qualitative approach to interpreting the data. Our goal was to investigate how our student groups adapted the email technology to address the requirements of the business case. Analyses reported in this paper were based on data gathered from the email discussions of the various groups, student evaluation comments for the course, and a methodical evaluation of the problem-solving, discussion, and learning processes together with an assessment of the quality of the final group product according to a standardized scheme developed by the researchers. The email data was gathered during a two-week time period in October and November of 1994. This represented a period of email use that followed eight prior weeks of use of this technology for other class assignments. Email discussions of members in each group were captured by the researchers and subsequently printed to hard copy for use in the contextual analyses and evaluations. Student evaluation comments were extracted from reflective notes completed by the students as part of another course assignment and course evaluations.

Inputs	*Processes*	*Outputs*
Group Interaction Inputs	*Group Interaction Processes*	*Group Product Outcome*
Task characteristics (degree of structure, desired outcome)	*Group Problem-solving*: - problem identification - goal identification - alternative generation - selection of final recommendation	*Final recommendation* - form - content
Group characteristics (group size, cohesiveness)	*Group Discussion Process* - initiation of discussion - ongoing communication - concluding discussion	
Individual characteristics (computer anxiety, communication apprehension)	*Group Learning Process* - learning to adapt technology to needs	

Table 1: Particular elements of group process interaction, as applied to the specific model of group process interaction in Figure 2.

INTERPRETIVE ANALYSIS

Table 1 summarizes the key elements of our analysis, as derived from the specific model of group process interaction in Figure 2.

Group Problem-Solving Process

Our evaluation of each group's problem-solving process was based upon the following four dimensions: problem identification, goal identification, alternative generation, and selection of a final recommendation. In general, none of the four groups showed a systematic problem-solving approach that included clear problem identification, goal identification, and generation of alternatives that culminated in a final recommendation. Discussion in Groups 1 and 3 evidenced a typical problem-solving process often seen in actual work groups (see Hackman & Morris, 1975 as an example). These groups began their discussion by concluding that merging the various data base systems was necessary. There was no discussion of alternatives; groups appeared to choose quickly their recommendation. A Group 1 member wrote at the end of the project that the two sites "didn't even agree on what the project was about." Discussion among Group 2 members showed that participants at both sites recognized the need to share information about their respective sites, but this group also adopted a single alternative as a solution without much discussion. One individual in Group 4 attempted to summarize the major points, but the clearest goal articulated in this group was "to finish this project." Essentially, all groups lacked a structured or systematic approach to problem-solving in this context.

Evidence of a muddled problem-solving approach was not surprising in light of prior research in computer conferencing (see, for example, Hiltz & Turoff, 1993; Sproull & Kiesler, 1992) and given the lack of specific instructions in this sub-task provided for the students. That is, a step-by-step process for identifying the problem, goals, and alternatives was not outlined for students before the project began. However, students at both universities had used email for the previous eight weeks to discuss information systems topics and cases that involved issues similar to those in the remote communication project. Nevertheless, this outcome shows the need for more specific problem-solving guidelines at the outset.

Group Discussion Process

When evaluating the general overall quality of the group discussion, we utilized three dimensions: (1) initiation of discussion, (2) ongoing communication, and (3) discussion conclusion process. We discovered a wide variation in discussion processes among our groups. Group 1's discussion was least successful. Half of the group (located in at one site) provided its recommendation without incorporating to any great extent the ideas from their counterparts at the other site. In contrast, Group 2 immediately adopted a "liaison" mode of communication when one member at each site assumed responsibility for sending and receiving messages. Group 2's discussion evidenced a fairly even exchange of ideas between sites with members actually responding to each other's ideas. The concluding discussion from Group 2 indicated a synthesis of the discussion topics. This group also circulated rough drafts of its final report. Group 3 started its discussion early, and their exchanges indicated a convergence of ideas after starting from rather divergent views. One member of Group 3 developed the group's recommendation by synthesizing the many views/ideas discussed by the group, but there was no group discussion about completing the task in this way. The messages from Group 4 were somewhat fragmented although the closing discussion indicated a synthesis of the participants' ideas. This particular group experienced more "technical difficulties" than the other groups, but Group 4 members persisted and completed the project by submitting a final recommendation. In summary, at least three of the four groups engaged in genuine discussion and exchange of ideas via email to complete the assignment.

The wide variation in group discussion patterns may be due to students' relative inexperience in conducting online discussions with group members who are not co-located. Up until this point in the term, groups had been engaged in email discussions with peers at the same geographic location. Any discrepancies, issues, or problems encountered during email discussions could be resolved in person by meeting each other in the student lab or at the next class meeting. The remote communication project did not have this same method of conflict resolution available. The lack of such agreed-upon and implicit mechanisms in group discussions often evidences itself as widely varying discussion patterns (McGrath, 1984). Although there are steps that instructors can take to smooth out the process of group discussion, some variation in discussion processes is normal due to varying interpretations of the group task, different group composition, and individual reactions to the group's usage of technology. As such, unless the variation in discussion patterns is unduly destructive, there is little need for worry on the part of the instructor.

Group Learning Process

In terms of learning to use the technology and adapting the medium to meet the needs of the task, analysis of the group activities again demonstrated a range of outcomes. A participant in Group 1 wrote at the end of the project, "our remote project did not go well." Several participants in this group at one site did not successfully use the medium in that they never established regular, ongoing exchanges with their counterparts at the other institution. Group 1 members reported unanswered email and misunderstandings regarding the messages that were received. It is possible that Group 2 members demonstrated the best use of the technology, although it is unclear if the learning was shared by all participants because this group adopted the liaison mode of communication. Participants in Groups 3 and 4 demonstrated improved ability in adapting the technology to meet their discussion needs as the project progressed. Particularly in Group 4, one site's members continued to respond and send messages to their counterparts at the other institution in spite of numerous computer "glitches," such as, for example, when their site's email system unexpectedly stopped functioning. In hindsight, Group 4's members may have learned the most about adapting the technology to their uses. As one Group 4 participant wrote, "the remote project was frustrating but it illustrates how difficult this type of project can be." In summary, students experienced at least some frustration using the medium, but their experience appeared to have heightened their awareness of the complexity of communication necessary for resolving this type of unstructured business task, whether in remote or face-to-face proximity.

Final Group Product

The final product (the business recommendation) from each group ranged from marginally adequate to acceptable. Group 1's report was so vague that it could have been the final recommendation in a variety of business situations. It was written as an outline that closely resembled material from the course text. Group 2 provided a better final product substantively although it was poorly worded and lacked editing. The final reports from Groups 3 and 4 showed consolidation of participants' ideas and were evaluated as acceptable.

The aim of this exercise was not geared to producing the quintessential recommendation. Rather, the two-fold goal was to expose the students to a remote communication environment and to use this experience to highlight issues in the use of computer-based communication technologies in classroom discussions and lectures. Although we would have preferred to see higher quality in the final reports, the lack of high quality was not considered a project failing. Additionally, the timing of the remote communication project coincided with other end-of-quarter deadlines and some uncontrollable system problems at both university sites. Given these conditions, the resulting group product outcomes are not surprising.

DISCUSSION

Limitations

Our study is limited in that it was posed as a pilot study for the deployment of remote communication projects in information systems courses; with further development our task would be stronger and provide better structuring of information for the groups. Our research framework and analyses are limited by the kinds of groups we were able to include in the research study (students), the size of the groups (on average, a total of nine students per group), and the composition of each group (on average, two students from the Michigan site and up to seven students from the Minnesota site); it is reasonable to expect that smaller, more evenly distributed numbers of students in groups might have quite different results. Further, our observations are largely qualitative and did not involve detailed coding or other quantitative approaches which might improve the research rigor and allow for greater generalization of results. Despite these limitations, our study did allow for a detailed view of the group problem-solving, discussion, and learning processes involved in the use of remote communication projects in information systems courses. This rich, descriptive view of the process can benefit future planning for and implementation of such computer-based communication technologies in other courses.

Implications

The practical implications of this assignment are apparent when the project's successes and failures are tallied. In the success column, we determined that this remote computer-based project heightened students' awareness of the difficulties that may be experienced in using technology to establish discussion groups at remote sites (Harasim, 1993; Wild & Winniford, 1993; Hiltz, 1986). Moreover, this assignment provided students with a tangible experience of using technology to complete an unstructured task so typical of decision situations in actual business settings (Bazerman, 1994; Sproull & Kiesler, 1992; Opper & Fersko-Weiss, 1992). This valuable experience could not have been replicated within the standard class format which utilizes lectures covering textbook material. Almost every student participated and, in doing so, took part in an active learning experience that involved actual operational issues of adapting the medium to meet the task's needs (Angelo, 1993; Johansen et al., 1991). In addition, the project promoted group work at both local and remote sites and promoted students' writing and communication skills.

In the failure category, we communicated the "what" of the assignment but not the "how." That is, we instructed students as to the nature of the task but provided little structure for tackling such an unstructured problem. As a result, students paid little (if any) attention to the problem-solving process and jumped immediately to the conclusion, with minimal discussion, that all human resources systems for the company should be consolidated. The lack of structure in the process may have compounded the frustration of using the technology to establish discussion at a remote site. This frustration also may have derived in part from the dramatic difference in group membership at each site. For one class, there were too few groups which resulted in the combined group having a vastly different participation ratio by university site (e.g., 2 Michigan students and 7 Minnesota students in one group). In addition, there was little evidence that students' prior use of the technology prepared them for establishing discussion using email across sites. As for the case itself, it could be strengthened to include a better articulation of the company's goals. Although one of the objectives of the project was to involve students in an unstructured task that would simulate an actual business decision situation, we needed to realize that our students were, after all, *students* who generally lacked experience at tackling this type of problem. These and other evaluations give rise the following recommendations provided below.

<u>Recommendations</u>

We recommend this type of project for creating an active learning experience, but in our next assignment we will attempt to prepare students earlier in the term for the project. We will establish each of the "task forces" so that they are composed of equal numbers of students from each institution. Initiating groups earlier would also allow group members the opportunity to introduce themselves and establish a working relationship before the remote communication project assignment is introduced. In addition, we will demonstrate in earlier assignments a standard problem-solving technique that requires problem identification, goal identification, alternative generation, and alternative selection. We will add to the task's structure by making more clear the company's goals but allow the problem to retain its essentially unstructured nature. This recommendation is in keeping with our goal of providing students with problem-solving experience that closely resembles actual problems that are rarely clear-cut.

CONCLUSION

In summary, there were many positive aspects of this learning experience for both students and instructors. For the most part, students eagerly tackled an unstructured business problem (without adequate preparation at the outset), and they learned to persist in the face of technology that did not operate reliably. They learned by establishing remote computer-based discussion that the process was equally important as the product. In such an active learning environment, it became apparent that course material from the text did not quite capture some of the difficulties involved in problem-solving and in adapting the technology to meet students' needs. Upon reflection, it is our belief that integrating a remote communication project into an information systems course is a worthwhile teaching method.

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APPENDIX

REMOTE COMPUTER-BASED ASSIGNMENT
[Course name, term, instructor name]

Context/Background/Overview:
You and the others in your group are members of the Human Resources Department of a large midwestern privately owned company that develops and manufactures medical devices. Currently, the company has 2 primary centers of operations, one in [specific site name], Michigan, and one in [specific site name], Minnesota with smaller sites in California and Vermont where specialized components are manufactured. The components are shipped to Michigan and Minnesota where the finished products are assembled.

Each division of the company has had autonomous control over its own production and business policies for the past 15 years. Matters related to the hiring, promotion, firing, and retirements of the staff have always been under the control of the Department of Human Resources in each division. Data that are stored and managed at each site include personnel records of all current and past employees, length of employment, and employees' benefits information (health, life, and disability insurance, opportunities for educational advancement, vacation and sick leave status reports, etc.). Each Human Resources Department is also responsible for keeping on file employees' resumes and resumes of prospective employees who apply for positions.

There is a mainframe and/or minicomputer at each of the company's centers of operations where a database of the employee records is stored. Accessing the database to locate information for a particular employee can be time consuming, but in general each division's Department of Human Resources believes that the present system functions reasonably efficiently. At times, it is important to consolidate employee information from the entire organization, and this task has proven to be quite time-consuming and at times, almost impossible.

There is a tradition at the company of working together to address business challenges. Often, decision making is handled verbally and informally. As a result, sometimes record keeping has been informal or even non-existent. This tradition extends to the management of the human resources function. There are a number of unique work processes and routines that are a part of the everyday functioning of each Human Resources Department.

The senior Vice President for Human Resources [instructor name] has heard of a new commercially available software application system, PEOPLEWARE, that would enable the company to integrate into one system all the Human Resources records currently stored and managed at each site. She thinks this idea is worth investigating. At the very least, she believes that the development of a uniform system would enable senior management to have a better overall picture of the work force. At a recent meeting of senior management, several voiced a concern about maintaining the company's profit level and a need to centralize activities across the organization's four divisions. The Vice President admits that this is not her area of expertise. She does not know, for example, what exactly is involved in consolidating all the Human Resources Departments at the various company locations into one integrated system accessible by department members at each site. The Vice President is appointing a task force to study this situation and make a recommendation.

Your role:
Your group has just been selected as one half of the task force that has been asked to study this issue and make a recommendation. You will work with your counterparts from the [specific MI site] division using e-mail. At your next class meeting, you will be provided e-mail addresses of the Michigan task force members.

Your task:
Working together via e-mail, your should "discuss" the ramifications (technological, organizational, and managerial) involved in this issue. Ultimately, the task force will send a final report via e-mail to the senior VP for Human Resources with your analysis. She will want you to include a summary of the advantages and disadvantages, the costs and benefits of the potential change. Your analysis of the situation should demonstrate your understanding of the unique processes and routines at the company's two main centers of operations. Finally, you are provide a recommendation as to whether this project should be pursued. As you discuss the issues with the task force members in Michigan, remember to include the Vice President on the your e-mail distribution list [instructor email address] so that she will be aware of the issues that the task force discusses.

The Minnesota Context:
At [specific MN site], the Department of Human Resources is supported by an IBM 3090 with an IDMS network database management system. The department is usually "bombarded" with employee applications. Unfortunately, resumes that are given to the department seem "to disappear" into the system; a specific resume of a particular candidate employee is rarely found.

Another issue for the [specific MN site] department is its need to share information with the people in the Accounting Department. The Human Resources Department have become accustomed over the years to the complaints from the folks in Accounting who are always asking for updated benefits information. In Minnesota by state law, employees are entitled to change their health insurance providers during a certain "open enrollment" period each year. Often, employees do make changes, but Accounting complains that the Human Resources Department does not provide the updated records in a timely manner.

For additional information or assumption concerning this assignment, contact your Vice President, [instructor name at MN university].

The Michigan context:
The [specific MI site] employees of this firm have a long history and tradition of working together to address business challenges. A great deal of decision-making is handled verbally and informally. As a result, record-keeping is not very formal and sometimes non-existent.

This tradition extends to the management of the human resources function -- there are a number of unique work processes and routines that are part of the everyday functioning of the HR group. Examples of these unique processes and routines include:

- On the last Friday of each month there is a special celebration for all people who had birthdays that month -- small gifts for the "birthday people" with cake and beverages for all attendees. The system that is used to track the staff's birthdays is the HR group's dBase extraction program that runs as part of the HR information system.

- Job applicant's resumes are often sent directly to the hiring manager within the [specific MI] site (i.e., production, finance, IS, etc.), though resumes are also sent directly to the HR group. The Divisional hiring policy is for the hiring manager to notify the HR group of all resumes received and to ask if there are any other resumes of job applicants received by HR. The hiring manager should then receive all resumes and select interviewees from this pool of job applicants. HR is then to be notified of the selected interviewees so that information can be collected for EEO reporting and initial interviewing schedules can be set up with the applicants.

Additionally, the [specific MI site] is supported by an IBM 4381 mainframe computer. The [specific MI site] also utilizes the IMS hierarchical database management system for its major systems, including the HR systems for payroll, employee benefits, and all hiring records.

Questions regarding the details of the Michigan context should be addressed to the VP of Human Resources, [instructor name at MI university].

Quality, Assessment and the Information Systems Curriculum

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ABSTRACT

The need for assessment as part of a quality improvement program is established. Principles for building an effective assessment program are discussed. Institutional quality is related to "talent development" and it is shown that assessment may be used to promote talent development. The "Input-Environment-Output" assessment model is presented. A process for applying the model to assess curricula is proposed. The model is applied to an existing Information Systems program. Future activities are indicated.

THE NEED FOR ASSESSMENT

Concern with outcomes assessment is not new in higher education. Researchers, practitioners, and policy makers have long urged colleges and universities to measure the impact of their educational programs (e.g., Bowen (1974)). In the decade following Bowen's work several national reports highlighted the promise and potential of outcomes assessment as tools for institutional self-improvement, but few educational institutions heeded the call.

A decade later, in 1983, A Nation at Risk took aim and fired its salvos at the American educational system, initiating an intense re examination of the quality of teaching and learning at all levels of education. In the mid - 1990s, educational reformers are seeking answers to two fundamental questions: (1) How well are students learning?; and (2) How effectively are teachers teaching?

The first question is being addressed by the current assessment movement. Heavy public and political pressure is on colleges and universities to explain their objectives and demonstrate how well they are meeting their objectives. A majority of states have mandated some form of assessment for higher education, and most colleges have at least begun to plan ways to assess the effectiveness of their programs.

A major problem of the assessment movement is that faculty members are not fully involved in the process, typically perceiving the movement to be little more than another "make-work" project that comes top-down from the institution's administration. While faculty grant that proper assessment might indeed aid in the student learning process and thereby provide real benefits, they wonder if the possible benefits derived from these assessments justify their costs? While it is difficult, especially in today's academic climate, to be "against" assessment, a growing number of reasons can be heard supporting the position that assessment is ill advised within a particular institution at the present time. Ewell (1984) cites many frequently heard comments ranging from impossibility to lack of student and/or faculty cooperation to skepticism regarding potential misuse of the resulting data by the college administration.

But the benefits of assessment can be quite substantial! The revised accreditation standards of the New England Association of Schools and Colleges state "... while assessment is an overall institutional concern, as reflected in the various standards for accreditation, its primary focus is the teaching-learning process. To the greatest extent possible, therefore, each educational institution should adopt reasonable performance standards for its students and adopt reliable procedures for assessing those achievements."

If the primary benefit of assessment is improvement of the teaching-learning process, then any useful assessment must therefore have the following minimum set of characteristics: 1. The assessment should produce data relevant to issues affecting the teaching-learning process as defined by the faculty; 2. The assessment should provide data about students' change and development, not just an isolated snapshot of student competencies at a single point in time; 3. The longitudinal data collected should include information about students' educational experiences so that the effects of these experiences can be assessed; and 4. The results should be both analyzed and presented to the faculty in a manner that facilitates their use by teaching practitioners.

BUILDING AN ASSESSMENT PROGRAM

Alexander W. Astin, Director of the Higher Education Research Institute of the University of California, Los Angeles (UCLA) has proposed (1993) nine principles for building and employing an effective program for assessing student learning. Designed to help educators in the process of evaluating their current student assessment practices, these principles are: 1. The assessment of student learning begins with educational values; 2. Assessment is most effective when it reflects an understanding of learning as multidimensional, integrated, and revealed in actual performance over time; 3. Assessment works best when the programs it seeks to improve have clear, explicitly stated purposes; 4. Assessment requires attention to outcomes, but also and equally to the experiences that lead to those outcomes; 5. Assessment works best when it is ongoing, not episodic 6. Assessment fosters wide improvement when representatives from across the educational community are involved; 7. Assessment makes a difference when it begins with issues of use and illuminates questions that people really care about; 8. Assessment is most likely to lead to improvement when it is part of a larger set of conditions that promote change; and 9. Through assessment, educators meet responsibilities to students and to the public.

ASSESSMENT AND TALENT DEVELOPMENT

Implement an institutional program of assessing student outcomes should be based on a coherent philosophy of institutional mission. The program should reflect some conception of what constitutes "effective performance" of that mission. In fact, it is common to define a high quality academic program as one which effectively performs its mission.

"Excellence" and "quality" are perhaps the most fashionable terms in discussions of education these days. But even though many of us are fond of talking about excellence, we seldom take the trouble to define what we mean by the term excellence. The two most common approaches to defining institutional excellence have been labeled by Astin (1985) as the "reputational" and "resources" approaches. The reputational view holds that an institution's excellence is equated with its rank in the prestige pecking order of institutions as revealed in periodic national surveys. The resource approach holds that excellence is equated with such criteria as the test scores of entering freshmen, the endowment, the physical plant, the scholarly productivity of the faculty, and so on. These approaches are mutually reinforcing in that enhanced reputation can bring an institution additional resources, and additional resources like highly able students and a nationally visible faculty can enhance an institution's reputation.

A major limitation of these traditional approaches is that they do not necessarily reflect higher education's most fundamental purpose: the education of students. If higher education's principal reason for being is to develop the talents of students, then "quality" or "excellence" should reflect educational effectiveness rather than just mere reputation or resources. This alternative conception of excellence has been labeled the "talent development" view (Astin, 1985). Under this view, a high quality institution is one which maximizes the intellectual and personal development of its students.

These alternative views have important implications for institutional assessment. Under the reputational and resource approaches, attention is focused on the entering students as reflected in standardized admission scores and high school grade averages. Students who are high achievers are thus viewed as important institutional resources which tend to enhance the institution's reputation. Under a talent development approach, assessment should focus more on changes or improvements in students performance from entry to exit.

The talent development approach may be applied to an individual campus as follows: Newly admitted students are tested to determine their entering level of competence for the purposes of counseling and placement. These initial scores provide information about a particular student's strengths and weaknesses and establish a baseline against which to measure the student's subsequent progress. After the student completes a course of study, the same or similar assessments are repeated and the difference in performance is used to provide critical information about the student's growth and development - both to the student and to the professor and the institution. Outcomes assessment from a talent development perspective is thus characterized by longitudinal (pretest and posttest) designs in which a group of students are tested with the same measures at different times, thereby providing measures of growth and change over time.

There are essentially two different ways that assessment can be used to contribute to the talent development of students: (1) through direct effects on the learner and (2) indirectly by enlightening the educator. For example, assessment directly affects the learner when students are motivated to learn because they know they will be examined, or when they improve their knowledge or competence as a result of the feedback they receive from a test. Similar direct effects occur when professors strive to be more effective teachers because they know they will evaluated by their students, or when they improve their teaching as a result of the feedback they receive from such evaluations and from their assessments of students.

Assessment can promote talent development more indirectly when it enlightens or informs the educator about the effectiveness of various educational policies and practices. In fact, most of the discussion and debate about assessment concerns this indirect use of assessment rather than assessment designed to influence the learner directly. Perhaps this is because the principal means by which assessment results can help to enlighten professors and administrators is their use as an aid to decision making. Educators are continually confronted with decisions that can affect the talent development process: what to teach, how to each it, whom to admit and on what basis, how to orient and advise students, what courses to require, how to structure the student's residential and social life, and how to test and evaluate student's performance. These decisions involve choices among alternative courses of action: this requirement rather than that requirement, this teaching method rather than these other methods. Assessment results, if used properly, can be of considerable value in making such decisions because they can provide information about the likely impact of alternative courses of action.

Researchers in the 1950s and 1960s focused on traditional notions of excellence in doing their assessment studies. They tested hypotheses equating institutional excellence with both reputations and the resources of institutions. To their surprise, they discovered their hypotheses to not be true. Rather, these early studies were critical in teaching us three fundamental lessons about assessment in higher education:

1. The output of an institution or program, whether we measure this in terms of how many graduates earn advance degrees or by some other means, does not really tell us much about the educational impact or educational effectiveness in developing talent. Rather, outputs must always be evaluated in terms of inputs.
2. An output measure such as Ph.D. productivity is not determined solely by a single input measure such as student ability. On the contrary, other input variables such as the student's sex and major field of study are at least as important as ability in determining Ph.D. outputs.
3. Even if we have good longitudinal input and student output data, our understanding of the educational process will still be limited if we lack information on the college environment. For example, it is one thing to know that your college overproduces or underproduces Ph.D.s, but it is entirely something else to understand why. What is it about the environment that causes it to over- or under-produce? This suggests that input and output data, by themselves, are of limited usefulness. What we need in addition is information about the student's environment: the courses, programs, facilities, faculty, and peer groups to which the student is exposed.

These early lessons rapidly led to the conclusion that any educational assessment project is incomplete unless it includes data on student inputs, student outcomes, and the educational environment to which the student is exposed. Astin (1993) illustrates this model as follows:

| Environment |

| Inputs | ⟶ | Outputs |

"Outcomes" refers to those talents we are trying to develop in our educational program . "Inputs" refers to those qualities the student brings initially to the educational program, including the student's level of developed talent at the time of entry. "Environment" refers to the student's actual experiences during the educational program. Environment is of special interest since it includes those things that the educator directly controls in order to develop the student's talents. A fundamental purpose of assessment is to learn as much as possible about how to structure educational environments so as to maximize talent development. Intuitively, we might speculate that the most effective educational environment varies relative to the inputs supplied by the student; we would seek to verify this hypothesis through assessment.

ASSESSING THE INFORMATION SYSTEMS PROGRAM

Assessing the information systems program involves implementing the I-E-O Model as follows:

Step 1: Reexamining the Department Mission Statement. Assessing the curriculum starts with a reexamination/generation of the department mission statement. It includes a statement of department mission that is consistent with institutional mission and a listing of those things to which the department is committed in achieving its mission. It concludes with specific curricular learning objectives that the program attempts to achieve in the educating its students. For example:

Statement of Mission: "The mission of the Department of Information Systems is to support the goals of the College and the School of Business by developing graduates with the professional information management skills to compete successfully in a technologically advanced global economy. The focus of the Department in on excellence in teaching."

Department Commitment to Achieve It's Mission: "In support of its mission the Department is committed to: 1. Continuous improvement in faculty teaching capabilities; 2. Technological currency in its hardware platform; 3. Utilizing current software in the process of systems development; 4. A view of systems development that adheres to the principle of integration of systems and management information; 5. A student-centered curriculum constantly updated to keep pace with current industry and professional needs; 6. A curriculum in which depth of knowledge is developed, in part, by treating subject matter at increasing levels of competency and sophistication; 7. Creating a mutually-supporting community of students, faculty, and staff in which each individual is treated with dignity and respect; and 8. Offering an individualized student-faculty relationship that supports student learning and career development."

Curriculum Learning Objectives: "In order to compete successfully in the information management arena in a technologically advanced global economy, student education is designed to accomplish the following learning objectives: 1. Accept continuous improvement and lifelong learning as organizational and personal goals; 2. Comprehend the importance of information utilization as both a personal and corporate resource; 3. Analyze, design, develop, and evaluate computer information systems to help provide solutions to information needs; 4. Comprehend the range of existing and emerging information technologies and apply that comprehension to the selection of specific technologies, including personal computers, to satisfy information needs; 5. Synthesize individual and corporate information needs with other organizational concerns in prioritizing information systems for both corporate and personal development; 6. Develop an increasingly in depth understanding of one's chosen field and its relationship with social, organizational, and individual concerns; and 7. Develop graduates who are responsible citizens, active in the development of their communities.

These learning objectives are accomplished through a carefully integrated sequence of courses which maintain a strong emphasis on the development and improvement of the fundamental skills of communication, analysis, synthesis of ideas, team development, advancement of solid ethical standards, and formation of sound technical judgements. The curriculum emphasizes the employment of structured systems development tools within an overall life-cycle approach focusing on the study, design, development, implementation, and continued operation of computer-based information systems in which concurrent prototyping is acknowledged and practiced as a tool for speeding up the development cycle."

Step 2: Completing the "Learning Objectives: Course Responsibility" Matrix: The next step in a successful assessment program is to determine which educational experiences are to be assigned responsibility for working toward and/or attaining a specific curricular learning objective. Several course work on particular objectives at different points in time with course assignments/activities mutually reinforcing each other and/or developing increasing sophistication in a particular curricular learning objective.

This step is accomplished through the generation of an "Objective-Responsibility Matrix" in which course objectives are listed as column headings and educational experiences (usually courses) are listed as row headings. The goal of this exercise is to determine which courses and educational experiences will be responsible for addressing particular curricular learning objectives. Each objective is normally addressed by more than one educational experience, implying a growth pattern corresponding to both educational and personal continuous improvement and an increasingly sophisticated understanding of the field of study and its impact on society.

Step 3: Determining Course Sequencing Pattern.

Department courses are planned to occur in a sequential pattern because the output of one course as applied to a particular learning objective can be used as input to another course as applied to the same learning objective. Further, the sequence of courses will impact on particular course learning objectives, which will be a subset of department learning objectives.

Step 4: Learning Objectives Measures Determination. The goal here is to measure the input abilities of our students. The process starts with developing/selecting measures used to construct a pre-test to be administered to our entering students. The "best" assessment instrument is one that most closely matches the goals and values of the department and the structure of the curriculum. Several fine instruments exist; although they are not institution specific they are generally field tested and their strengths and weaknesses have been the subject of research over the years. They exist to measure a wide range of cognitive concerns and subject areas at levels appropriate to both lower-division and upper-division students. Perhaps the best known and most widely used is the American College Testing (ACT) Program's College Outcomes Measures Project (COMP). The ACT COMP was designed to measure "general" outcomes of college students abilities "to apply specific facts and concepts in work, family, and community roles" (Forrest and Steele, 1982). That is, the ACT COMP is designed to measure students' competence in three content areas (functioning within social institutions, using science and technology, and using the arts) and three process areas (communicating, solving problems, and clarifying values). The ACT COMP is combined with subject-specific tests that measure knowledge and content in the specific subject areas of the curriculum. A typical approach to the subject areas might be to include a selection of objective questions from final examinations of the required courses in the curriculum. Such a combined approach will yield an assessment of the curricular learning objectives that includes both attitudinal and content domains, thus providing a basis for both pre- and post-tests to measure student learning over time.

Step 5: Curriculum Learning Objectives Pre-Test. When freshmen arrive on campus they are tested to determine the current level of their talents and abilities relative to our desired learning objectives. The test is administered as part of the normal freshmen orientation program and serves two purposes: (1) it becomes the pre-test of our I-E-O Assessment model providing a baseline for measuring future growth of our students, and (2) it forms a basis for initial course placement. After all, with the wide variety of entering talent and ability levels of our freshmen, it is unwise to assume that all entering students should start at the same curricular level. Such a pre-test approach to placement is not new: it has long been employed for initial English and Mathematics courses, and over time it should become the norm for placement in Information Systems courses.

Step 6: Course Placement per Pre-Test Results. Pre-test results are thus used to place students in their initial Information Systems course. Given that our initial Information Systems course focuses on Information Technologies, we would expect a small percentage of incoming students to place into the second course, dealing with Object-Oriented Programming. Thus we have a basis for answering the questions of both students and their parents regarding course placement, providing a measure of accountability and rationality to our efforts to meet the needs of our incoming student population.

Step 7: Implementing Individual Course Structures Each course in the curriculum needs to be designed and implemented in a manner similar to the manner in which the entire curriculum is implemented. The process starts by determining individual course objectives consistent with the course's contribution to curricular objectives. Measures are then defined to assess whether students have met the course learning objectives, and individual students are pre-tested during the first week of class to assess their respective inputs to the given course.

The results of the course pre-test are used to design course activities to actively engage students in the learning process thus moving them towards the course learning objectives. Several models of course activities exist, among which are the "Student Assessment-as-Learning" model developed by Alverno College (1979) and those of quality guru Robert Cornesky (1993,1994) which guide classroom activities consistent with the principles of quality management. Whichever class activities are selected, the goal is to practice assessment in a course-embedded manner (Farmer, 1988). Assessment is thus viewed as both part of the teaching and learning process and as a means for providing input to improve the process, not as an add-on requiring further work on the part of the faculty.

At the conclusion of each course, a post-test is administered to measure student progress regarding learning objectives. Ideally, the post-test and pre-test will be the same, thus ensuring design reliability and a tighter degree of control in testing alternative instructional method hypotheses.

Step 8: End of Academic Career Activities. At the conclusion of the student's academic career, as part of the course design in the last semester, two activities take place. Students are again administered the test measuring progress regarding the curriculum learning objectives, ideally using the same test instrument that was administered at the time they entered the college. This serves as a post-test of curricular learning objectives, and together with the pre-test will serve as a vehicle for measuring talent development of our students. Examination of alternative course patterns among our students may lend knowledge regarding effectiveness of various courses, effectiveness of alternative instructional methods employed in different sections of the same course, and effectiveness of the methods of different course instructors. The goal here is not to form conclusions regarding faculty performance; rather, we seek to obtain feedback regarding different aspects of our curricular delivery system, thus obtaining objective data to design curricular improvements.

Also during the last semester our graduating students are surveyed for their opinions of the quality of their education . The survey is quite comprehensive, covering all aspects of their college experience.. We thus gather data from our client's point of view, providing valuable input into our continuous improvement curricular philosophy. We recognize that students are not really in a position to judge the effectiveness of the curriculum given they have little or no experience base with which to do so. Nevertheless, the old adage "Where There's Smoke There's Fire" usually holds true. Students are in a position to give us feedback regarding the effectiveness of systems, feedback that will provide valuable input into our decision making.

Step 9: Alumni Surveys. In fixed-year intervals, alumni are surveyed to determine their ongoing careers and their opinions of the effectiveness of their undergraduate experience. Alumni also provide valuable input of predicted future trends in the industry and proposed curricular changes to maintain curricular currency. Representatives of the alumni also serve on a Department Advisory Board which is of assistance on many matters, including curriculum design, internship placements, student full-time employment placements upon graduation, and the recruitment of new students.

CONCLUSIONS

The assessment model proposed herein is currently being implemented. The department mission statement has been formulated and curriculum learning objectives have been determined. The "Learning Objectives-Course

Responsibility Matrix" has been completed and the course sequencing pattern has been determined. Measures of the curriculum learning objectives are being formulated with testing of incoming freshmen scheduled as part of the summer freshman orientation program. This will become the pre-test for the assessment program.

Incoming freshmen are placed in either the first or second information systems course, both offered during the fall of 1995. For each course, individual objectives have been determined consistent with the curricular learning objectives and course responsibility matrix. Measures of individual course objectives are determined and the pre-test will be administered during the first full week of classes in the fall semester. Particular classroom assessment techniques employing course-embedded assessment structures are being formulated (Angelo & Cross, 1993). The entire course structures will be implemented for the first two courses in the curriculum during the fall semester.

Alumni surveys have been conducted periodically for the last decade. The process is currently being formalized through the development of a standard questionnaire and a scheduling of surveys such that all program alumni will be surveyed during their first, third, and fifth years after graduation, and every fifth year thereafter. Surveys have been mailed during the spring of 1995, and follow-up surveys are scheduled for distribution in the fall.

The implementation of the model is viewed as an assessment prototype. The model is consistent with Astin's principles for building and employing an effective assessment program. Continuous quality improvement of the curriculum is rapidly becoming a reality.

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Renewal of Network Systems Curriculum with Emphasis on Students' Lab Projects

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ABSTRACT

We have reviewed the Network Systems curriculum of the Department of Computer Technology of IUPUI, and have taken a major step to improve the program. The emphasis is with students' hands-on experiments which are conducted in a state-of-the-art, multi-protocol, instructional LAN environment. This instructional lab (with a token-ring, two Ethernet LANs, a local bridge, and two servers) will be linked to another instructional LAN. To develop an up-to-date plan, we have searched available literature and cyberspace. The information available in cyberspace, our lab plan, and refined curriculum are described. In addition, a fast and effective mechanism for sharing of results on curriculum development efforts is suggested.

1. Overview of CPT programs, our Network Systems Focus

The Department of Computer Technology (CPT) of the School of Engineering and Technology, Indiana University - Purdue University at Indianapolis (IUPUI), offers programs at both the associate and bachelor's degree levels. These programs are designed to provide an applications-oriented, practical education that prepares students for careers as systems analysts, programmer/analysts, or network systems specialists.

Students may earn Purdue University Associate of Science degrees in computer technology at IUPUI. The associate degree program has two (2) options designed to prepare graduates to work in either commercial or technical areas. Students may choose to continue their education, rather than entering the job market, upon completion of their selected associate degree option. For these students, as well as those who return to college after a period of time of gainful employment, the educational opportunities for a B.S. degree are available.

Students may earn Purdue University Bachelor of Science degrees in computer technology at IUPUI. The bachelor's degree is available in three (3) tracks:

- a Standard Track with selected concentrations
- a Business Track that also earns a minor from the School of Business, Indiana University
- a Technical Track that also earns a minor from the Department of Electrical Engineering Technology

Furthermore, the department offers a Minor in Computer Technology to those students who are majoring in other areas of study at IUPUI. The Computer Technology Minor is designed to provide a basic set of computer concepts and programming courses along with a sequence of computing specialty courses.

Network Systems curriculum components are an integral part to each of the aforementioned programs:

- In A.S. degree programs, as required principles
- In B.S. degree programs, as required principles, and then depending on the track chosen, as either: (a) elective courses, (b) selected concentration, or (c) selected track requirements.
- In the minor, as a selected specialty

Our history of Network Systems curriculum development has been rather long. A data communications course was initiated over twenty-seven years ago. The curriculum has been expanding since then to meet the needs of students and local industry. For a brief historic view, see Appendix II - Yesterday, Today, and Beyond of our Network Systems.

The basic segments of our Technical Track bachelor's degree that focuses on Network Systems are:

- 18 credit hours in Network Systems (Computer Tech.)
- 38 credit hours in other Computer Tech.
- 19 credit hours in Electrical Engineering Tech.
- 26 credit hours in mathematics & physical science
- 24 credit hours in general education

The department currently has ten full-time faculty members of which four have been involved in teaching Network Systems courses. About thirty part-time faculty members are also currently teaching. Two of the part-time faculty have a high degree of expertise in networking and communications as consultants in industry.

Goals and Challenges

Our primary goal is to enhance the quality of education in the areas of our expertise, computer technology. This will necessitate a concerted effort involving changes in methodology and mechanism of instruction delivery with respect to the teaching/learning process. Another goal is to expand our partnerships with industry in a manner that shares some common aims. We also need to improve the manner in which we change.

The field of Network Systems has been developing rapidly, and the applications are exploding in business, industry, and government. Network Systems importance and influence are continually increasing. An NSF 1992 workshop report [1], stated

> In particular, there exists an urgent need for educational and research programs to produce students having a background in experimental research and in systems integration. Experience in these area is necessary if students are to be productive in an industrial setting.

The above statement has been validated in a recent article, *Demand for IS talent soars*, February 13, 1995 issue of COMPUTERWORLD: "People with networking and Oracle Corp. database skills in particular can pretty much write their own ticket." Since the inception of the Network Systems course in 1968, instruction on the subjects has been limited to classroom-based lectures and discussions, supplemented with demonstrations at some cooperative site, due to the lack of a lab with adequate facilities.

The growth within our technology and the expansion of the applications of our technology, at ever increasing rate, present some real challenges. Coupling the technology changes with the funding and budgeting constraints that are facing our university, one can recognize the high degree of complexity of the problem. Attempting to apply these factors to our network systems curriculum is indeed a challenging task. To meet the needs for refinement and upgrade of the curriculum, we will need to work not only harder, but more importantly, smarter. Obviously, the number of courses on the subject cannot keep increasing. The technology itself may well hold some of the keys to the answers we need.

Fundamental to the teaching/learning process in technology education is the utilization of lab facilities. With state-of-the-art hardware, software, and techniques, we can increase the volume and improve the quality of the material delivered. This increase in instructional productivity of the faculty members must also be in an environment that is conducive to the improved effectiveness of student learning.

CPT has identified the Network Systems curriculum as its most significant priority for new instructional development. Both current as well as emerging market needs and technological trends provide compelling motivation for this curricular initiative. In the following sections, components of joint curriculum and laboratory development efforts of the Computer Technology Department, the Electrical Engineering Technology Department, and the Computer Science Department of the School of Liberal Arts and Sciences are summarized.

2. Instructional Lab Development

There are three labs within the CPT Department: two are for instruction and one is for faculty development. Of the two instructional labs, one is the Networking Lab (SL 209), the other is the CASE Lab (SL 223). In addition, several labs with LANs are provided by the School of Engineering and Technology; two of these are in the department building. These "School" labs are linked by backbone to a SUN Network Server to deliver "school-level" services. In-turn, the school-level system is connected to a router linked to a campus-level router. The Integrated Technologies (IT) office manages both campus and inter-campus routers and also provides computing services with an IBM 3090/180J supporting CMS, a DEC VAX 7600 supporting VMS, and an IBM RS 6000 supporting UNIX. (There are over 200 LANs on the campus). Access is also provided to computer systems on other I.U. campuses as well as to network services for the Internet. Most of the LANs are interconnected; from any instructional node, students can gain access to a wide range of computing resources. However, these systems are supporting application packages, programming development, and databases for the students.

A different type of lab environment is required for students to conduct their Network Systems experiments. Our instructional lab will have computers and networking devices without any restrictions imposed by system administration/security staff of the other services centers. To meet the market demand for well-trained graduates and to upgrade the mode of instruction used in our Network Systems courses, it is time to incorporate lab-based hands-on experiments along with classroom-based lectures, discussions, and demonstrations. Our instructional lab development efforts have the following three objectives:

- To build an infrastructure of an instructional lab for the networking and telecommunications curriculum
- To develop an experimental LAN to which networking and communications devices can be attached and tested
- To initiate a project-based learning approach for networking and telecommunications courses

The lab is the precursor of major curriculum renewal efforts. While the lab facilities are gradually established and expanded, the curriculum for CPT Network Systems will be improved continually for the next two to three years as discussed in Section 4. The scope of instructional use of the lab will be expanded every semester. By using the lab facilities, the students will gain hands-on experience in both networking and applications integration. In the field of Network Systems, graduates will be knowledgeable and more productive when they enter industry. Other technology students of the School will also have access to state-of-the-art quality training required in their disciplines for their careers in industry. The successful completion of this project will help CPT to provide quality education, develop technical leaders, and conduct applied research in this period of unprecedented demand for laboratory experiment based education.

The lab development project will essentially follow the LAN building steps that are used in industry (for the CPT Dept Networking Lab facility is basically a LAN facility). A tentative list of equipment the and software are in the informative areas of the WEB page, of the department, http://www.engr.iupui.edu/cpt/. The overall project consists of two phases: Phase I - Develop an infrastructure of the lab, Phase II - Integrate the lab facilities into the curriculum.

Phase I - Develop an infrastructure of the lab: to be completed during the summer of 1995

1. Needs analysis based on student lab projects
2. Select equipment and software
3. Create a lab configuration plan
4. Develop a small scale LAN lab

The LAN's preliminary configuration is depicted in Appendix III LAN Configuration. At the completion of the step 4, an Ethernet LAN with a server, five to ten workstations and a printer, all attached to 10BASE2 cables, will be available. NetWare v3.12 is the initial candidate for the network operating system.

Phase II - Integrate lab facilities into the Curriculum: to be undertaken during the academic year 1995-96.

5. Initiate curriculum revisions for Network Systems courses
6. Create a timetable for a full scale lab development
7. Full-scale LAN lab development

Some of the initiatives of Step 5 are addressed in Section 4. Step 7 consists of two tasks. First, development of two LANs: a three to ten node token ring and another three to ten node Ethernet LAN on a hub, both are linked by a local bridge. Second, installation of a router to link our multi-protocol LAN to an instructional LAN in the CPT Department at Purdue University, West Lafayette, in an internetworking environment. In order to complete Phase II of the project successfully, CPT will search external funding resources.

When the lab is completed, CPT will be able to develop non-instructional applications of the lab facilities. The faculty and students of CPT and EET can offer equipment/protocol testing services to local industry using the lab facilities. As the faculty and students gain knowledge on specific characteristics of many networking devices and software packages, they can offer consulting services to local business and industry. Eventually, a database on networking and telecommunications equipment and protocols can be developed for the use of local business and industry. The same lab facilities can be used for network trouble-shooting and other projects by students taking EET communications courses.

3. Searching for up-to-date Information on Network Systems

Recently, the networks and communications area has been evolving at a faster, unprecedented rate than any other technology has experienced before; Stallings [2] described the status clearly:

> Because of the pace of change of technology and the rapidity with which new products and services are being introduced into the telecommunications arena, CCITT is finding that traditional four-year cycle is inadequate. This is especially so in the case of broad band ISDN. However, even in the ordinary ISDN area, there is a desire to produce results outside of the normal four-year schedule. Accordingly, a number of the CCITT working groups published interim new recommendations and interim revisions to existing recommendations in 1990.

An educational institution and its' instructors must maintain their credibility and integrity by keeping pace with the advances in technologies no matter how fast they are changing. Sometimes we have to depend on the original source of the information as early as it is released. Fortunately, some networking equipment vendors and telecommunications services providers have Interactive Voice Response systems with fax-back information server, which send up-to-date information on equipment and services to the customers based on their request codes. We were able to obtain the accurate status of ISDN services available in the region from Ameritech Information Server [3].

In addition to conference proceedings, professional magazines or newspapers, and research journals, cyberspace continues to help us to find the directions which other educational institutions are taking with their Network Systems curriculum [4]. Some selected Internet Universal Resource Locator (URL) addresses are listed in the following along with page titles. Most of the descriptions are taken from the home pages.

- http://www.lii.com/~dhjordan/isworld/undergrad.html: Data Communications provide information for data communications instructors and students on undergraduate data communications course content and online information resources and tutorials.
- http://gozer.idbsu.edu/business/nethome.html: Distributed Electronic Telecommunications Archive project is intended as a demonstration vehicle to show

how information useful for teaching and learning about business telecommunications and data communications may be effectively shared over the Internet.

- http://alnilam.ucs.indiana.edu:1027/sources/programs.html: Directory of Communication Programs is a list of communication programs in institutions of higher learning with 33 institutions at the moment of this writing.
- http://ei.cs.vt.edu/EIproj.html: EI Project Home Page has links to Courses, Digital Library: xprcedit access to page images (from X Windows only), Project Overview, and WWW94 paper by Fox and Barnette. The Courses has links to complete descriptions for fourteen computer science courses.
- http://WWW.sangamon.edu/~hadidi/ISWTelecom.html : ISU Graduate Course Descriptions: Telecommunications is an entry point for various resources related to teaching a graduate level telecommunications course in Business Schools.

It looks like cyberspace is growing fast, has a non-measurable potential, and has a strong possibility of generating a few shinning stars soon.

4. Curriculum Development

The ACM/IEEE-CS Joint Curriculum Task Force Report [5] on computing curricula published in 1991 has "Computer Communications Networks" included in Section 14 Details of the Advanced/Supplemental Material. The topic Summary states:

> This topic gives students a foundation in the study of computer networks. Current methods and practices in the use of computer networks to enable communication are covered. Also covered are the physical and architectural elements and information layers of communication network, along with diagnostic, design, operational, and performance measurement tools that are used to implement, operate, and tune such a network. . . . Important subtopics include . . .

The above is a recommendation for baccalaureate programs in the disciplines of "computer science," "computer engineering," or "computer science and engineering". No curriculum recommendation is currently available for Network Systems for computer technology or electrical engineering technology discipline. References to Network Systems type undergraduate courses are traceable though various Data Processing Management Association's Model Curricula. Throughout the 1980s, courses relating to Network Systems were seen as "Elective Courses". The position of our CPT Dept has been that these courses are an increasing part of our requirements since the early 1970s.

Currently, the department's WWW pages include information for both perspective students as well as presently enrolled students. Curriculum information is available both as semester-by-semester calendars, as well as course descriptions. This Internet capability places the latest available information into the hands of those who need it the most, our students. It is noted that our School publishes a "Bulletin" (school catalog) every 2 years. Like many such documents, parts of it are out-of-date by the time they are available for distribution. Our Internet information is the latest official word, and proceeded the next School Bulletin by months.

Briefly, our present Network Systems course offerings include 6 courses;

- CPT 240 - Introduction to Data Communications and Networks (basic concepts, then emphasis on LANs)
- CPT 301 - Queuing Theory and Traffic Analysis (network problem definition & analysis techniques)
- CPT 303 - Communications Security and Network Control (techniques of security, encryption, & protection)
- CPT 341 - Data Communications (continuation of CPT 240, emphasis is on WANs)
- CPT 402 - Design and Implementation of Local Area Networks (LAN design with emphasis on actual implementation)
- CPT 440 - Communication Network Design (integration of hardware/software in LAN/WAN network)

The current schedule of offering these courses are: CPT 240 is offered every semester; CPT 303, CPT 341, and CPT 440 are offered at least once annually; CPT 402 is planned for spring 1996 (During the last two academic years, unfortunately, CPT 402 has not been offered for lack of appropriate lab facilities); CPT 301 has yet to be offered. The current and new text books for most of these courses are listed in Appendix I. In addition to the text books, copies of professional newspaper articles, copies of research journal articles, and copies of selected sections of computer system vendor manuals are used as required for the courses.

The Electrical Engineering Technology Department offers a LAN course: EET 483, Industrial Local Area Networks. Currently, there are no facilities available in the department for hardware-oriented lab experiments for the students to gain experience making cables, using LAN cable testers, working with punch blocks, etc. The Computer and Information Science Department offers an undergraduate and graduate level course, CSCI 536, Data Communication and Computer Networks.

Step 5 of Phase II of the lab development project is closely tied with the efforts for the CPT Networks System Curriculum improvement. Step 5 will be divided into two parts, A and B. In Part A, efforts will be focused on CPT 402 - Design and Implementation of Local Area Networks. Detailed student lab projects including network configuration; setting up a network, including node and interface card selection, software selection, connecting nodes with cables, and software loading; protocol analysis; and network monitoring will be specified. This lab will also allow experiments with video conferencing over a LAN. The traffic load generated by video conferencing can be used to demonstrate the relationship between various network configurations and network performance. COMNET III will be used for performance simulation of various network configurations and protocols. Part B, will be focused on the development of an on-hands lab for a new course on Network and Internetwork Security. Also during the part B period, a new (yet un-named) lower level communications and networks course with hands-on students' lab projects will be developed. This new lower-level course may replace CPT 240.

Although there are many books on networking and communications, some are too advanced, and some are too simple. Texts with balanced material on both hardware and software are needed. Few books are available for intermediate-level instruction in networking with an integrating approach to hardware and software. Some video tapes are available. Recently, Tape 3: Traffic, signaling, Switching; Tape 4: Transmission; and Tape 5: Network Architecture and Services of Bellcore Telecommunications Overview packages [7] were used to supplement CPT 240 lectures. These available tape materials do not seem adequate for an advanced level course for integrating networking hardware/software components into a complete working system.

5. Computer Aided Instruction/Learning and Digital Libraries

CPT faculty members have been using industry materials along with professional publications and research journals to develop instructional materials. Materials from these sources are not often designed to meet instructional objectives. The task of converting and integrating this material is very time-consuming. In order for the faculty to cover even a portion of the ever-increasing amount of material on a subject, to convert it into effective teaching module, and for the students to learn, faculty productivity must be increased, and student learning effectiveness must be improved.

In an article of the on-line service, Computer Select, Olympia stated: "Today, CAI is making a comeback and getting hot, fueled by technology advances and an ever-increasing demand for training [8]." Encouraging results on a computer-aided lecturing process are reported in the IEEE Transactions on Education [10, 11, 12]. Fox and Barnette argued successfully that [9] "Learning will be enhanced if we can provide interactive hypermedia courseware, and if we have powerful digital libraries (DLs) to work with, then both learning and course development will be more efficient." On the topic of digital libraries, a special issue of Communications of the ACM, April 1995 - Vol 38, No 4, has numerous articles on the subject. There are major-scale, concerted efforts for developing digital libraries for various disciplines. We will use digital libraries for Network Systems course development as they are available. In addition, presentation/projection tools such as PowerPoint [13], along with a network illustrator, SYSDRAW, will be utilized to increase faculty productivity as well as to improve student learning effectiveness.

A networking and communications protocol defines movement control of information in packets or frames. Protocol functions can be animated with a simulation language supporting computer animation. MODSIM II is such a language [14]. To make the dynamic phenomena of protocol functions clearly visible, computer animation techniques will be used as an instructional delivery tool.

6. Network Performance Simulation

During the last two decades, leading research teams and the computer aided engineering industry have focused on computerization of electronics design processes. Their efforts have been very successful, and recent developments in Graphical User Interface (GUI) techniques have made many of the Computer Aided Engineering (CAE) tools easy to learn and easy to use. In particular, Network Systems simulators are maturing quickly. Several tools are available for performance simulation of networking and/or specific communications functions.

Among several Network System analysis packages based on the Discrete-Event-Simulation technique, COMNET III has been found to be a stable tool with pre-defined libraries of network objects and an animation capability for object movements [15]. It has been used by most major communication networks developers including AT&T Bell Labs and Martin Marietta. The package supports all of the prevailing and emerging network architectures and protocols. As new protocols and standards gain acceptance, they can be easily integrated into the existing simulation models. This simulation tool, COMNET III, is ready to be included into a high level engineering and technology curriculum.

The importance of simulation verification is identified in Section 6, *Priorities for basic research* of the aforementioned NSF report [1]. For networks and communications performance simulations, recent research activities are focused on execution time reduction [16]. For small to medium scale network simulation, COMNET III is efficient enough to run on Pentium-class PCs. The upper-level students' instructional/research project activities will be focused on the procedures to verify and to validate performance simulation results of small to medium size networks. Students will conduct simulation experiments, and analyze the results for verification and validation. For lower-level courses, the animation feature of the COMNET III will visualize network traffic movements through the links of a network.

7. Participants to the Lab Development

An instructional LAN lab development is not a large scale, but a complex project. The complexity of the project is due to the many types and the large numbers of available equipment/software from various vendors. The CPT Department has decided to utilize a wide range of resources. A proposal has been prepared jointly by our CPT dept and the dept of Computer Information Systems Technology at Ivy Tech State College (Indianapolis campus) for the development of interdisciplinary associate degree program. Two part-time CPT faculty members with extensive Network Systems consulting backgrounds will add their expertise to the project. A local commercial Internet access-services provider has joined the effort. Two other full-time CPT faculty members will contribute their specialties: one has extensive multimedia and teaching expertise, another with a joint appointment in Electrical Technology(EET) has extensive hardware/software integration and teaching expertise. Students, who have experiences in LAN management and/or network administration, will participate in the identification of student projects and in all phases of the lab development. In that the bachelor's degree includes a Minor in Electrical Engineering Technology, continuing efforts of a collaborative program development is essential to the two departments, the students, and the accreditation processes.

8. Project Evaluation/Assessment/Dissemination

The progress of the project efforts will be periodically reviewed by the Curriculum Committee of the CPT department. As soon as any curriculum, schedule or hardware/software problem is detected, they will be addressed, and resources will be brought to produce corrective action promptly. No significant risks are perceived for the proposed project. Progress and results will be shared first with members of the CPT department of Purdue University, West Lafayette, for their evaluation. Intermediate results will be reported via WWW HTML documents for wide, fast dissemination.

With approximately 2 years of experience with the project, a workshop on integrating students' lab experiments into Network Systems curriculum is expected. The workshop will focus on utilization of the instructional lab facilities. Our experiences gained through the project and material developed for students lab projects will be shared with others participating in similar activities.

9. Summary and Conclusion

After an overview of the history and status of our Computer Technology programs and particularly the Network Systems components, the initial efforts to renew our Network Systems curriculum are described. An instructional lab development plan, a summary of the information on Network Systems curricula available in cyberspace, and computer assisted techniques to improve the effectiveness of the teaching/learning process are discussed. Within the instructional lab project, specific lab facilities, a configuration of a multiprotocol LAN, and implications to our course content are reported. To improve instructors productivity and to increase the students' learning effectiveness, CAI and CAL will be expanded in the Network Systems curriculum. In particular, a network performance modeling package, COMNET III, will be used with the emphasis of simulation verification and validation.

Finally, we plan to share our results with colleagues in the Networks and Communications education via WWW. Although we did not find much on complete programs on Networks and Communications in cyberspace, a thorough description was found on a computer science program. Our Internet presence has already been accomplished. We are continuing to expand and improve several curriculum descriptions that are available to prospective students as well as continuing students.

Acknowledgment

The authors wish thank to CPT student, Debby Kushner, for her drawing of the LAN configuration diagram in Appendix III.

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APPENDIX I TEXT BOOKS

1. CPT 240-Introduction to Data Communications and Networks
   Current: BUSINESS DATA COMMUNICATIONS: Basic Concepts, Security, and Design, 4th education, by Jerry Fitzgerald, John Wiley & Sons, Inc., 1993
   New: APPLIED DATA COMMUNICATIONS: A Business-Oriented Approach, by James E. Goldman, John Wiley & Sons Inc., 1995

2. CPT 341 Data Communications
   Current: BUSINESS DATA COMMUNICATIONS: Basic Concepts, Security, and Design, 4th education, by Jerry Fitzgerald, John Wiley & Sons, Inc., 1993
   New: APPLIED DATA COMMUNICATIONS: A Business-Oriented Approach, by James E. Goldman, John Wiley & Sons Inc., 1995

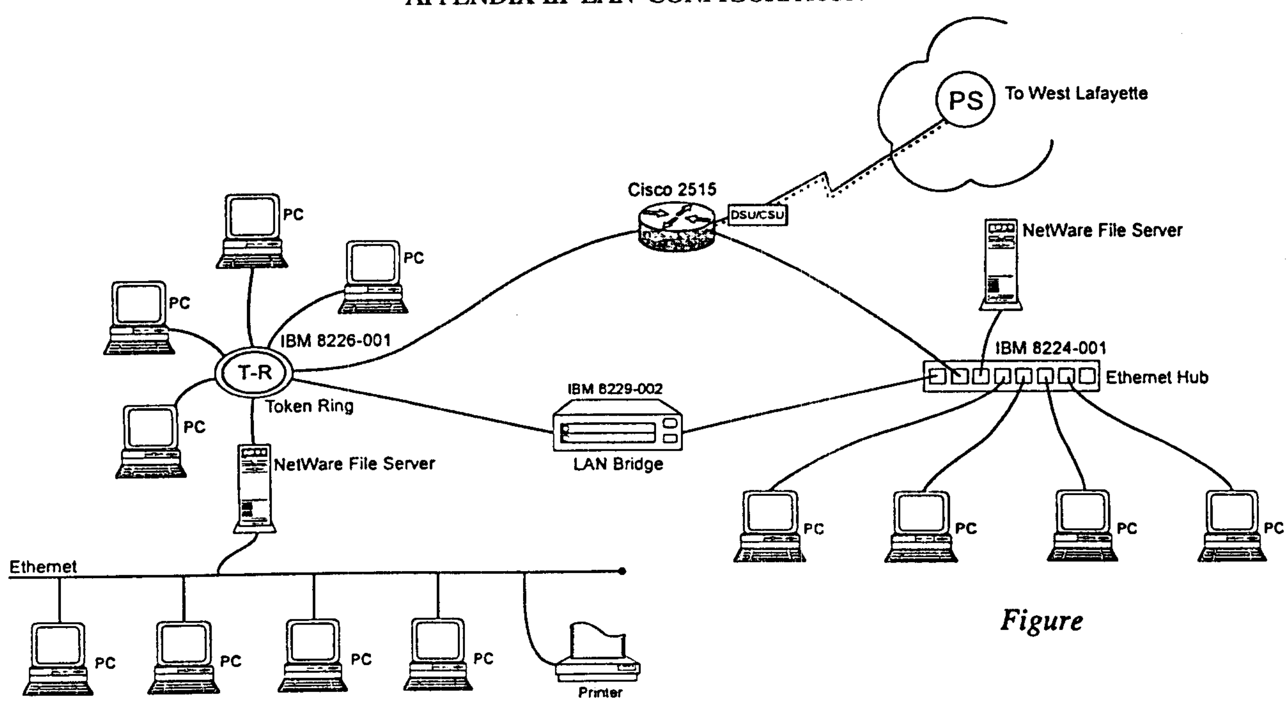
3. CPT 440 Communication Network Design
   Current: PRACTICAL NETWORK DESIGN TECHNIQUES, by Gilbert Held, John Wiley & Sons, Inc., 1991
   New: DATA NETWORK DESIGN, by Darremt L. Spohn, McGraw-Hill, 1993

4. CPT 402 Design and Implementation of Local Area Networks
   To be selected
5. CPT 303 Communications Security and Network controls
   Current: SECURITY IN COMPUTING by Charles P. Pfleeger, PTR Prentice Hall, 1989
   New: NETWORK and INTERNETWORK SECURITY: Principles and Practice by William Stallings, Prentice Hall, 1995

APPENDIX II YESTERDAY, TODAY, and BEYOND of OUR NETWORK SYSTEMS

DATE	CURRICULUM EVENT	ENVIRONMENT HAPPENINGS
Late 1960s	Introduce Data Comm. Course	RJE services supplement departmental computing
Early 1970s	Data Comm. course becomes req. "principles" in B.S. degree	IUPUI's Computer Services Center becomes statewide provider of time-sharing services to I.U. campuses. Inter-mainframe networking is introduced. Partnership with DEC is formed.
Late 1970s	Data Comm. course becomes req. in A.S. degree.	Available network services expand. Dept. computing becomes RJE and interactive terminal based. Private Univ. acquire services over Indiana Higher Education Telecomm. System (IHETS)
Early 1980s	Network Design course is introduced.	Industry networking architectures and standards become prevalent. LANs and PCs appear.
Late 1980s	Data Comm. course is expanded to 2 semesters. Survey of LAN Implementations course is offered. Industry "Seminars" are offered.	School of Engr. & Tech becomes alternate provider of LAN & VAX based services. Dept. sets-up networked CASE lab. in crowded quarters. State of Indiana initiates INTELENET project.
Early 1990s	Comm. Security & Controls course is offered. New program track with major emphasis in Network Systems (and ABET accreditation potential) is developed.	Dept. moves into new building with three lab rooms; CASE, Network, & faculty development. School & Dept. leadership change. Cooperative efforts with Elec. Engr. Tech. work. Internet and WWW service arrive. Dept Internet presence is established.
For the Late 1990s	Highest priority has been established for Network Systems efforts. Dept. Internet presence is expanded	AN EXPLOSION OUT THERE !
Toward 2001	Strategic Plan is initiated	? ? ?

APPENDIX III LAN CONFIGURATION



Figure

Implementation of a Joint Information Systems (IS), Computer Science (CS), Software Engineering (SE) CORE Curriculum Compatible with IS'95, CS'91 and SE'91 Computing Curricula

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Abstract

A review of model curricula developed for Information Systems, Computer Science, Computer Engineering, and Software Engineering reveals a significant similarity of material. This observation suggests that it should be possible to develop a common core curriculum that would satisfy the requirements of the three different disciplines. The vision and mission of this core must be sufficiently broad to encompass all three programs and meet any special characteristics of the individual disciplines. The core must provide the foundation for students to continue in their chosen programs. At the University of South Alabama, we have developed a core experience consisting of six semester courses equivalents that meets these needs. These courses cover three general areas 1) information technology, 2) algorithmic development, and 3) organizationally related concepts. These courses have been in place for one year. Initial indications are that they provide a suitable foundation for further study in all four disciplines.

Organizational Level	Discipline
Enterprise	IS
Department	IS
Individual	IS, SE
Software Application Systems	IS, SE
Languages - Database - Networks System Generators - Expert Shells	CS, SE
Operating Systems - User Interfaces Knowledge Systems Expert Systems - Communications Protocols	CS, SE
Computing and Telecommunications Devices and Systems	CS, CE
Chips, Components and Electronic Systems	CE, EE
Materials	Basic Scientists

IS	Information Systems	SE	Software Engineering
CS	Computer Science	CE	Computer Engineering
EE	Electronic Engineering		

Figure 1 - Organizational Level and Computing Discipline.

Breadth of Computing Sciences

The computing disciplines began to emerge as distinct from other areas such as mathematics, electrical engineering and management in the 1950s. As the discipline matured, separation into multiple disciplines took place. Four of the primary areas are commonly referred to as Computer Science (CS), Information Systems (IS), Computer Engineering (CoE) and Software Engineering (SE). A description of three of the related disciplines is shown in figures 1 and 2.

During the 1940s and 50s relatively small machines were programmed in assembler level languages. With the advent of FORTRAN, COBOL and ALGOL in the 1950s, focus could be shifted more to the problem domain. Added complexity of the machines and problem domain suggested the need for specially trained professionals Computing curricula first emerged in the 1960s. The rapid development of the computing industry was driven by commercial, scientific and military pressures. This explosive growth was reflected in the diversity of the professionals needed to develop, implement and manage the new complex systems. A necessary outcome was the development of different curricula to meet the diverse needs.

The Association of Computing Machinery (ACM) developed the first computer science curriculum (ACM 1968). Revisions were made in 1978 and 1990 (ACM 1978, Turner 1991). By the late 1960s Ashenhurst (1973) and others recognized that there was a fundamentally different discipline , Information Systems, involving computing that focused more on people and their achievements in a organizational context. Curricula models were developed by both ACM and the Data Processing Management Association (DPMA 1981, 1986, Longenecker and Feinstein 1991; and Nunamaker 1982, 1988; Longenecker et al 1995).

The need for a more disciplined approach to the development of software systems grew out of the failures of helter-skelter software development efforts of the 1960s and 1970s. The seminal work of Jensen and Tonies (1979) demonstrated the concept of applying the engineering method to the development of software or Software Engineering (SE). Subsequently, the Software Engineering Institute at Carnegie Mellon University assumed a leadership role for development of the discipline. The Institute has had significant impact on the development of SE curricula (SEI 1988, 1990, 1991). A common core for computer science and computer engineering was developed by the ACM and the IEEE Computer Society.

As programs in Computer Science proliferated, standards were developed. The Computing Sciences Accreditation Board (CSAB) was formed as a joint effort of the ACM and IEEE Computer Society to review academic programs in computing. The CSAB established the Computer Science Accreditation Commission (CSAC) to accredit computer science programs. Presently there are approximately 124 accredited programs. Accreditation of Computer Engineering is done by the Accreditation Board for Engineering and Technology (ABET). No accreditation exists presently for IS or SE programs.

Computer Science can be defined as "*the systematic study of algorithmic processes that describe and transform information: their theory, analysis, design, efficiency, implementation, and application The fundamental question underlying all of computing is "What can be (efficiently) automated?" (Denning 1988)*

Information Systems involves "*... complex socio-technical entities that have taken on critical roles in local, national and global organizations*" which "*provide support for the goals of the organization and its management -- strategic, tactical and operational -- in a timely and cost effective manner*" "*to improve the performance of people through the use of information technology...where the ultimate objective is performance improvement...where the focus is the people who make up the organization...*" (IS'95; Sprague 1993, p14)

Software Engineering is *the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software (IEEE 1990). "The two concerns that pervade software engineering are the complex requirements of systems and the need to build them economically in a for-profit environment. The context of software engineering tends to be software intensive systems that have substantial performance (real-time), capacity, reliability, security, and safety requirements; the discipline addresses how such systems are built and maintained in ways that are economically viable for the producers and users. (Ford 1995)*

Figure 2 - Missions of IS, CS, and SE Programs (Longenecker et al 1995). These definitions are important to incorporate into a "Core" mission statement.

Problems with Developing a Common Core Sequence Mission

The thesis of this paper is that it is possible to conserve resources in the first two undergraduate years by offering a curricula which satisfies the needs of many of the computing disciplines (see figure 3) (Longenecker et al

1995).

"The mission of the Computing Core Sequence (CCS) is to provide a rigorous and complete treatment of those concepts and applications common to computer science, computer engineering, information systems and software engineering. The material in this core should form the bases for students to successfully continue in specially differentiated programs in CS, CoE, IS or SE. The students should explore a wide class of ideas relative to the computing professions including the information technology, organization and management concepts, particularly as applied to the theory and development of systems and software. This core must impart in the students enthusiasm for the computing disciplines and confidence in the students ability to become successful practitioners."

Figure 3 - A Mission for the Computing Core Sequence (Longenecker et al 1995).

This is in contrast to the point of view of Glass (1992) who claims that each discipline has a very different focus. The fact that IS, CS, CoE and SE span such a wide level of organizational issues (see figure 1) and have relatively different missions (see figure 2) has lead to the conclusion (Glass 1992) that completely separate curricula are indeed appropriate. Numerous anecdotal conversations with faculty would indicate that a approach would be preferable to trying to find ways to accommodate the diversity in a common core approach. This point of view may also be partially fostered by the fact that the different programs usually reside in different academic units. This may cause competition rather than cooperation and result in academic "turf battles". In a time of shrinking resources and demands from the legislatures for accountability, a program that consolidates and conserves resources without compromising quality seems very timely.

At the University of South Alabama all of the programs in IS, CS, CoE, and SE are housed in a single academic unit, The School of Computer and Information Sciences. Degrees are offered in IS, CS and CoE with SE an option in CS. Faculty interests span the range of programs but are concentrated in IS, CS and SE. This has helped facilitate the development of the common core. This curriculum is entering its second year of successful operation.

<u>Implementation of the Core Computing Curriculum</u>

A review of the body of knowledge and the curricula derived from them shows that there is considerable

Computing and Information Applications
Systems Theory, Concepts and Applications
Modeling and Abstraction
Detecting, Framing and Solving Problems
Teams and Participative Processes
Object Oriented and Algorithmic Development
Computing Languages
Data Structuring and Related Function
Programming in C++
Software Development Methodologies
Computer and Systems Architecture
Operating Systems and User Interfaces
Client/Server Environments
Telecommunications

Figure 4 - Common Areas of Computing for Core Educational Objectives

overlap among the several disciplines (Longenecker et al 1995). This observation implies that courses early in the respective programs can be designed to capitalize on this overlap. The program at the University of South Alabama is equivalent to approximately seven semester courses. It acts as the core for all four majors and satisfies the mission in Figure 3.

The first course is usually taken in parallel with the first on algorithmic design and programming (Computing I). It covers background material on information technology, its uses and societal impact. This first course also covers systems theory and serves as an introductory service course for the university (similar to IS'95.1 in Longenecker 1995a). The material taught in this general introduction gives the flavor of the breadth first exposure (Tucker 1990; Turner 1990).

Figure 5 shows the essential components of the remaining courses for the first and second year course sequences. Our first year sequence grew out of the our experience with Computer I and II. This implementation is largely the depth first approach of CS 1991 (Tucker 1990; Turner 1990). The course has an active participatory laboratory component which draws examples from IS, CS, CoE and SE disciplines.

By the end of two years, our students have had a significant exposure to the concepts of algorithmic development in both the procedural and object oriented paradigms. Recently, Pascal has been used in the first year and C++ in the second, necessitating some coverage of syntax in the second year. As of the fall of 1995 C++ will be used in the first year. This will eliminate program syntax questions from the second year leaving more time for the software engineering, file and database issues. This sequence is fully compatible with IS'95.5, and achieves all of the requirements of CS 1991 (Turner 1991) for the Computer I, II "depth first" sequence.

Year 1 - Sequence A - Computing and Information Science Courses	Supporting Courses
Computer I,II (1 year) Computing Systems Algorithms Data Structures Programming (C++)	Calculus Statistics Composition
Systems, Information and Computing, Ethics	

Year 2 Sequence B Software Development (1 Year)	Sequence C Information Technology (1 Year)
OO Analysis/Design Programming(C++) File Systems Database Software Engineering	Computer Architecture
	Operating Systems
	Telecommunications

Figure 5 - Course Plan for USA Core IS, CS, CoE, SE Curriculum. The USA core curriculum requires three one year course sequences with supporting courses in mathematics/statistics, ethics, and systems and quality concepts.

In addition to the second year sequence just described, the students also take a sequence which covers computer organization, machine and assembler programming, operating systems and telecommunications. Both a theoretical and hands on approach are used. The objectives of this sequence are fully compatible with IS'95.4 and IS'95.6, and are also in accordance with the CS 1991 model (Turner 1991). One significant exception from IS'95 is that our sequence does not address systems integration (Trauth 1993) which must be deferred to upper division courses.

Issues to Address and Overcome

The previous curriculum at the University of South Alabama had only 1 1/2 semester courses in common. The new model was not adopted without concerns. Three issues were raised by the faculty during the development and implementation of the common core:

1. Are students in any of the majors compromised by a core program?

2. Is there enough time left in the undergraduate experience to develop discipline maturity?

3. Can faculty "give up" enough "turf" to facilitate program growth?

To help overcome reservations about the proposed chances, all faculty participated in all phases of the development. Course sequence design teams were chosen to give equal representation to the different disciplines. Faculty were able to choose on which teams to serve. A lead team made up of representation from sequence teams was formed to help provide coordination, to review all sequence team developments, and to resolve any conflicts. Thus, the question of giving up turf was avoided by creating something that was essentially new and owned by the teams, individual members and all faculty. Consistency as opposed to lock step conformity with the national CS and IS models was easier to achieve.

1. Are students compromised by a core program?

Over a five year period our first year program has evolved utilizing the ideas of IS'90 (Longenecker and Feinstein 1991; Gagne 1988; Bloom 1956) and IS'95 (Longenecker 1995a). The educational methodology of what might be called "continuing and continuous improvement, or each day learn a little and then add more tomorrow has brought our retention rates in the first year sequence from less than 30% to better than 85%. Anecdotal observations indicate that students continuing into the second year are doing very well and seem to be more "involved" with the program. It is too soon to know what the effects on graduates will be. The demands of the upper division courses are rigorous and it appears that the new core is helping ensure success.

2. Is there enough time left in the undergraduate experience to develop discipline maturity?

The core program is about 50% of the course work required in the majors. With the new core, students who enter the junior year are now more sophisticated in their computing knowledge. The advanced courses now can accomplish more than before. Another factor which may help in our environment is that most of our students Co-op or work part time. This has the effect of spreading out their education. Most of our students are taking 5-6 years to complete their degree. Concentrating on fewer courses permits more "soak time" and may impact in a positive way on our overall success.

3. Can faculty "give up" enough "turf" to facilitate program growth?

Although our academic unit is a collection of faculty of diverse backgrounds with strong disciplinary allegiances. For a number of years prior to working out the core program, courses were planned and assigned along disciplinary lines and there were no concessions necessary. In developing the common core, the faculty made the decision up front to agree that there would be a core, and that it would produce students who could continue in any of the majors. Constraints of the IS'90 as well as the CS 1991 models were to be observed. The educational mechanics of the Gagne 1988 and Bloom 1956 as utilized in IS'90 and IS'95 were adopted. Any disciplinary demands that were considered unnecessary and excessive to the other disciplines were deferred to the junior year. Examples requiring the more rigorous prerequisites, such as calculus, were modified. Thus, we demanded of each other that we respect our diversity, and the program is considerably stronger.

Conclusion

The impression of the faculty is that the core sequence represents an improvement for all disciplines. The core is not the turf of any discipline, yet is respected as a legitimate path for all involved. The success of the students with the IS'90/'95 methodology has been a very significant plus.

Acknowledgements

We wish to thank our colleagues who have participated in this project: Roy J. Daigle, Robert Daniels, Michael V. Doran, Thomas Hain, Glenda S. Hayes, Janet Kemp, David L. Langan, Marino J. Niccolai, William N. Owen III, Sharon Vest. The following graduate students also made significant contributions to the process: John Olson, Harold Pardue, Sastry Tatapudy, Ronald L. Williams.

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Introducing Team Projects in the Applications Development Cluster of IS'90: A Principle-Centered Approach

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Abstract

The importance of team projects in the Information Systems curriculum has been stressed in recent DPMA model curricula. These curricula also suggest that team projects should be integrated early in the curriculum. The purpose of this paper is to propose a method for integrating team-oriented activities into the Applications Development cluster in a step-wise manner using Stephen Covey's Principle-Centered Leadership paradigm as a model for the integration.

Introduction

According to Shonk [1982] a group is a collection of two or more individuals who convene for some common purpose; a team is a group working on a common goal that requires a cooperative effort among its members. There is some interdependence among team members: dependence on each other's services, sharing or supplying resources, making joint decisions, and coordinating efforts to accomplish an overall goal [Shonk, 1982].

In previous Information Systems (IS) curricula, team project activities have been primarily confined to the Systems Analysis and Design or Database courses. The importance of team projects in the Information Systems curriculum has been stressed in recent DPMA model curricula [Longenecker and Feinstein, 1991]. These curricula also suggest that team projects should be integrated early in the curriculum. Some issues of group-related activities in the Applications Development cluster have been addressed [Stemler and Chrisman, 1993; Chrisman and Stemler, 1994; Daigle & Kemp, 1993; Daigle & Kemp, 1994]. However, even in those courses for which group activities are traditionally expected, there is scant attention given to preparing students for a group-oriented activity. Although their experience has been primarily with individual, independent activities, students are expected to possess an innate ability to effectively collaborate with others. The challenge facing educators is determining a means of introducing students to a group culture. How can students be prepared for team-related activities? How can educators foster gradual growth through the curriculum? Stephen Covey's Principle-Centered Leadership (PCL) paradigm [Covey, 1991] provides insight for responding to these issues. The PCL paradigm is a prescriptive approach for an individual to mature into interpersonal relationships through four levels.

The purpose of this paper is to propose a method for integrating group-oriented activities into the Applications Development cluster in a step-wise manner consistent with curricula objectives, thus providing a foundation for ensuing project-based courses. The remainder of this paper is divided into three parts. The first section provides a general description of the model upon which the method of integration is based. The second section describes the approach taken to accomplish the step-wise integration in the Applications Development cluster. The last section explains the relationship of the approach to project-based courses occurring later in the curriculum.

The Principle-Centered Leadership Paradigm

Covey asserts that people want meaning and purpose in their lives - they wish to be managed by principles. The same conclusion applies to students and their acquisition of knowledge in their courses. Covey [1991] offers a paradigm for management, Principle-Centered Leadership (PCL) that consists of i) a means of assessing the level of interpersonal relationships present in a project, ii) a continuum for maturing into interpersonal relationships. Establishing a vision and a direction for individuals involved in groups is fundamental to effective use of the PCL paradigm.

The four levels of interpersonal relationships in the PCL paradigm are: Personal, Interpersonal, Management, and Organizational. Each level is associated with a principle. Covey asserts that PCL is most effective when practiced from the inside-out. That is first attaining personal competence and integrity, then acquiring interpersonal skills to work in groups, gain more interpersonal skills to manage a group, and, ultimately, gaining the ability to organize a group. The levels and the principles are summarized in Table I.

Covey furnishes seven habits [Covey, 1989; 1991] as a guide for individuals to progress through the continuum's three stages of maturity: Dependence (the initial stage), Independence (competence and responsibility for choices), and Interdependence (the highest stage--made by choice). The first three habits, for proceeding from Dependence to Independence are: *Be proactive*, *Begin with the end in mind*, and *Put first things first*. The next three habits, for progressing from Independence to Interdependence are: *Think win-win*, *Seek first to understand...then to be understood*, and *Synergize*. The last habit is a reminder of the continuing need for (professional) growth and renewal: *Sharpening the saw*.

The PCL paradigm provides a model for use by both an instructor and student for maturing into group relationships. The Dependence-Independence-Interdependence continuum and the seven habits provide guidance for evolving to team-oriented projects. The PCL paradigm provides a means of assessing the level of interpersonal relationship that is present in a team effort.

Practicing the PCL paradigm from the inside-out is a method for gradually introducing students to team-oriented activities. The level of these activities increases from the first course through the third course corresponding to Covey's four levels. The next section explains how the PCL model may be used to integrate team-oriented activities into the Applications Development Cluster.

Modeling PCL in the Applications Development Cluster

As has been reported in [Daigle and Kemp, 1993] and [Daigle and Kemp, 1994], the redesign of our Applications Development sequence to comply with IS'90 curriculum guidelines makes use of class assignments. The integration of team-oriented activities is initiated in the first course with the class acting as a single instructor-managed, cooperative group. In the second course, small instructor-managed, collaborative groups are formed. In the third course, small self-managed, collaborative teams first complete an instructor-directed project and then a team-directed project. Commitment is achieved through student participation in the development of a shared vision and direction [Gronbaek, Bodker, and Bannon, 1993]. Table 2 shows the components of the Applications Development sequence according PCL levels.

Shared Vision and Direction. A group can be more effective in their work when there is a shared vision (what are we trying to achieve) and an established direction (how will the vision be achieved) [Covey, 1991]. The first step to adopting the PCL paradigm can be made by fostering a collaborative attitude in the classroom. The collaboration becomes a means of establishing communication among students to develop a shared vision and direction. The instructor serves as a guide using curriculum objectives as a compass; the class becomes a single problem-solving group.

Our approach for fostering collaboration in the classroom begins with the analysis of a scenario involving several embedded objects. The shared vision developed for the first two courses and part of the third course in the Applications Development cluster consists of a schema and an associated menu structure for a system of applications for the schema. Once the shared vision and direction are established, they are referenced and revisited throughout the three course sequence. The remaining subsections describe the step-wise approach to modeling group-oriented activities according to PCL levels.

Personal Level. Developing individual competence should be the objective of assignments at this level; students who do not acquire technical expertise become a burden for future project teams. Individual assignments reinforce the accountability for competence; meeting the requirements of a performance evaluation confirms competence and therefore trust in one's own abilities. Participation in class discussions to develop the shared vision and direction, demands a higher level of communication among students [Stice, 1987].

For the Personal level, our approach is to guide the class to the discovery that control - b r e a k applications are a possibility whenever there is a one-many association between two objects. In-class exploration of ways to fulfill the performance agreement raises issues of implementation and provides ample opportunity to explore concepts involving project management, database, and programming. Successfully completing the assignments and active participation in class discussions provide information to the class about the competence and trustworthiness of a student. The class establishes the performance agreement by cooperating to prepare report specifications and developing a project plan for implementation.

Interpersonal. The objectives for this level should be to continue the development of individual competence and to introduce small-group activities. Individual assignments should continue professional development and competence building. Group assignments should foster development of an individual's responsibility to a small group. Group activities should promote trust among group members and provide a forum for communication and problem solving external that is external to the in-class experiences. Performance agreements should be structured so that both individual and group-related assignments can be evaluated.

For this level, our approach is to guide the class to focus on the development of the system defined by the menu structure developed in the first course. The class is divided into small programming groups of three or four students; each group has responsibility for implementing the system. For individual accountability and competence, each member of a group is assigned one entity class in the schema to implement. Each student receives a text-file driven menu program that navigates the menu skeleton. Groups have two assignments. The first group assignment is to design a standard *look* and *feel* independent of entity class selected for their system. The second group assignment is to integrate and test the complete system before demonstrating the final system to the class. Each group demonstrates its version of the system through presentations of the individual assignments of group members. Performance evaluation of individual and group assignments are made by the instructor and are supplemented by self-evaluation and member-evaluation of participation and cooperation for the group assignments.

Management. In addition to extending individual competence, the objective of this level in the PCL paradigm is to incorporate greater interdependence in the project activity--teams must evolve. Team members collaborate and cooperate to plan and manage a project identified by the instructor. Decisions regarding individual assignments, however, are made by the team. Students confront and deal with conflicts between individual and team goals through individual performance agreements within the team. Performance agreements between a team and the instructor should convey that each team member should be capable, given adequate time, of replicating the project entirely on his own. This requirement encourages each individual to share information and techniques and to be aware of the contributions made by other team members. In-class problem-solving and collaboration should be a model for team activities.

Our implementation of this level occurs in the first assignment of the third course of the Applications Development sequence. The assignments in the third course are all team-oriented. Teams are self-managed for the relational implementation of the system from the previous two quarters. The assignment can only be completed in the available time if the group functions as a team--i.e. manages their interdependence. Although the mastery of the chosen DBMS to complete the project is shared, each student is responsible for acquiring competence to implement a similar system without assistance. Individual activity and time recording, self-evaluation, member-evaluation, system presentation to the class, and accountability for understanding the contributions of other members assist in quality control.

Organizational. The objective for this level is to extend individual competence and interpersonal skills through self-managed, self-directed team activities. The instructor provides curriculum-based guidelines for project complexity. The project definition, analysis, design, planning, implementation, testing, and presentation are organized by each team. Requiring a formal presentation rather than a demonstration emphasizes that the organization for presentation differs from that used to complete the project. Performance agreements at this level should emphasize individual accountability.

Our implementation of this level occurs with the second team assignment of the third course. Teams collaborate to select a database problem, to generate solution requirements, to develop a schema, to design a system interface, to establish a testing plan, to implement the chosen solution, to document the complete process, and to deliver a formal presentation (35-45 minutes) of the project to the class and invited guests. Examinations assess individual knowledge and skill; the formal presentation, self-evaluation, and team-member evaluation provide information about individual contributions to the team project.

Observations and Extensions.

Using the four levels of the PCL paradigm in conjunction with in-class collaboration and assignments is a realistic approach for the step-wise integration of team-oriented activities. Using this approach in the Applications Development Cluster extends the student's professional competence (Personal level) established in the Algorithms Development with the inclusion of group-related activities. By placing limits on interdependence activities in the second course (Interpersonal level), the ability to evaluate individual growth is not sacrificed for initial group experiences. By imitating the project activities of previous instructor-directed projects, groups gain experience with self-management (Management level) and, consequently, are prepared to be self-directed (Organizational level) for the final group project.

Commitment is a consequence of in-class collaboration and project ownership. Once a classroom dialogue is established and the desire to control all activities for the class is suppressed, the instructor is freed to assist students to meet curriculum goals. The instructor becomes a facilitator, a coach, a resource, and the caretaker of the vision and direction. When students are empowered to assist in structuring their learning environment, they are more committed to the course, take greater pride in their assignments, and are more willing to make investments in the learning of their peers.

Senior Projects Course. The DPMA model curricula IS'90 [Longenecker and Feinstein, 1991] specifies a capstone experience for IS graduates. Integrating team-oriented activities in a step-wise manner in the Applications Development prepares students for this capstone experience in at least two ways.

First, competence and maturity in the discipline, and conceptual knowledge and technical skills, are intrinsic to the PCL paradigm. Lack of discipline, competence, and maturity in the Senior Projects course are obstacles to success. Time, energy, and resources used to overcome knowledge and skill deficiencies cannot be recovered when time is a constraint-- a minimal set of prerequisites is necessary to facilitate team communication.

Second, the PCL approach supports the proposition that skill for working effectively in groups is also fundamental to maturity in this discipline. It follows that students should not be placed in a situation which demands skills and maturity that have never been previously addressed. Integrating team-oriented activities according to the PCL paradigm permits a student to develop interpersonal skills and gain maturity over time. Communication skills development occurs when the class functions as a group. The development of these communication skills increases with the increased complexity of interpersonal relationships needed for the projects of the Applications Development sequence.

In summary, Covey's Principle-Centered Leadership is viewed as a prescriptive model for integrating team-oriented activities into the Applications Development cluster. The paradigm provides a means of assessing the level of interpersonal relationships present in a project--Personal, Interpersonal, Management, and Organizational. The Dependence-Independence-Interdependence continuum and the seven effective habits are guides for maturing into interpersonal relationships. Participation to develop a vision and a direction for individuals involved in groups creates a sense of ownership and commitment.

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LEVEL	PRINCIPLE	CHARACTERISTICS
Personal *Relationship with self*	***Trustworthiness***	Character and Competence--integrity, maturity, and an abundance mentality permit a successful transition to the Interpersonal level.
Interpersonal *Relationships with others*	***Trust***	Basis of Win-Win performance agreements--fosters communication, problem-solving, empathy, synergy for productive interdependence
Management *Responsibility to contribute to group projects*	***Empowerment***	When previous two levels are attained, groups can be self-managed--self-governed by win-win performance agreements that address the common needs and goals of individual and organization
Organizational *Need to organize people*	***Alignment***	Common vision for the organization developed through a collaborative approach and achieved through empowerment

Table I
Four Levels of Principle-Centered Leadership

Sequence Components	*Levels of Principle-Centered Leadership*			
	Personal	*Interpersonal*	*Management*	*Organizational*
Assignments	Individual	Individual, Group	Team	Team
Performance Agreements	Class developed	Class developed; Group agreement	Team developed	Team developed
Project Management	Class developed	Class developed	Team developed	Team developed
Vision and Direction	Class developed	Class developed	Class developed	Team developed
Project Evaluation	Individual	Individual, self, associates	self, associates	self, associates
Product Review	Individual submission	Individual demonstration with associates	Project demonstration, explanation to class and instructor	Formal project presentation--all members participating
Communication	Class participation, assignment documentation	Class participation, interpersonal in group, assignment demonstration	Class participation, interpersonal in team, project demonstration, time-sheets, explanation to class and instructor	Class participation, interpersonal in team, project presentation, time-sheets, project documentation
Competence	Exams, assignments	Exams, assignments, project demonstration	Exams, project demonstration	Exams, Project presentation, documentation

Table II
Application Development Sequence Components According to PCL levels

ARE WE PREPARING OUR STUDENTS FOR THE REAL JOB MARKET?

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ABSTRACT

This paper presents the results and findings from a study of job listings for information systems (IS) positions in Computerworld, a national weekly IS newspaper. A detailed search of advertisements for IS professionals was made and data collected regarding job titles, processing environments, and software skills. The results indicate what is hot and what is not in the job market for IS professionals and provide some trends over a period of three years. This paper should be of interest to college and university IS majors (and prospective graduates) and faculty as a guide as to what is looked for by IS employers.

INTRODUCTION

There is always some debate in colleges and universities about the balance between theoretical and practical knowledge in every curriculum. The information systems (IS) field is no exception. Interesting courses or interesting bodies of knowledge have their place. However, the reality is that once a student graduates, he or she needs to be able to find a job. Employers recruit on campus to find employees that will fill a need. If the students have the skills to fill the need, then they are considered for the position. If they do not have the skills, then they usually are not considered for the position.

Colleges and universities are continually revising their curricula to keep up with what they believe are the needs of the times. The programming languages that IS majors should learn, the processing platforms they should be familiar with, and the other skills they should have are subjects of constant collegial debate. Courses are being introduced in decision support systems, expert systems, CASE tools, data structures, networking, the Internet, security, data bases, data modeling, object-oriented analysis and programming, and a myriad of other subjects. The curricula is crammed full and many students have to take courses that the professors want to teach. With all the things students are being taught, are we really preparing them for the real job market?

This paper is an initial effort to look at the job market and try and determine what employers are asking for in the positions they are advertising for. Snapshots of the job market are taken for three consecutive years in January and July to identify what employers are looking for in IS hires. Examined were job titles, processing environments, and software skills. It is believed that this study will provide one look at the job market for IS professionals and can provide college and university IS faculty with some insight into what is hot and what is not in the IS job market.

METHODOLOGY

The basic methodology for this study was to examine the want ads from Computerworld for the past three years. For the basis of this analysis, the first two issues in January were used for 1993, 1994, and 1995, and the first two issues in July were used for 1992, 1993, and 1994. This allowed more than a single time period to be analyzed. The rationale behind the use of Computerworld was that it is the one information systems-related publication that exclusively carried want ads for the information systems field from nationwide sources.

Each ad in Computerworld was reviewed and counted according to job titles, processing environment, and software skills. If an ad listed more than one possible title, processing environment, or software skill, then all of the titles, environments, and software skills were included. Job titles that appeared less than 5 times and job titles clearly unavailable to graduating seniors (e.g. IS Manager) were not shown in the final analysis. Many advertisements, especially those from search or employment companies listed many different processing environments and numerous software skills. As a result, there is a considerable difference between the total number of references for each of the three categories studied. Since the main idea of this study was to survey the job market and identify jobs, environments, and software skills needed for hiring companies, this difference in the number of references was not considered a problem, but a better indication of what was wanted in the job market by hiring firms.

It was recognized that there would be some limitations to using data from Computerworld advertisements. First, few advertisements in Computerworld are for recent graduates. Most of the advertisements want people with at least two years of experience. It was believed, however, that the advertisements used reflect the general needs and trends in the industry for the three categories. Therefore, they should be somewhat representative of industry's needs for college graduates. Second, the Computerworld advertisements do not necessarily reflect the job market in any one section of the country or in the specific areas of any individual institution. They do represent overall needs within the country as a whole. Each educational institution must be aware of the skills and educational needs of their graduates and of the needs of the recruiters that recruit their graduates.

RESULTS

The results of study are summarized according to the three general categories of classifications: job titles, processing environments, and software shills. It should be noted that, in every classification, January totals were 150-180% higher than July totals. This may be attributable to two things. First, many companies' fiscal year starts in January. These companies may be looking to hire for any unfilled positions at that time. The start of the fiscal year is a good time to bring these people on board. Second, there seems to be a holiday lull in many personnel activities during the last of November (Thanksgiving) and December (Christmas). January seems an appropriate time to start the hiring cycle again. Therefore, it seems reasonable that the January numbers in all three categories would be higher than the July numbers.

Job Titles

Table 1 presents a summary of the job titles listed in the advertisements. A review of the table shows several trends. First, the title of Programmer/Analyst is by far the largest job title sought by employers. This job title represented about 30% of all job titles for both January and July. Other job titles with 30 or more total listings in both January and July include: Data Base Administrator (99 total listings), Software Designer/

Engineer (96), Consultant (82), and Systems Analyst (65). Most of these jobs are directly related to systems development, an area that seems to be a prime target for most IS human resource recruiters. The numbers for most of the categories remained somewhat steady over the years for both January and July.

When looking for trends for individual job titles with more than 10 listings, only one category seemed to be declining (EDP/IS Auditor), while two seemed to be increasing (Object Oriented/ Data Modelers and Security Administrator). These job titles reflect an increased awareness in relatively new tools (object oriented analysis and design and data modeling) and in increased security needs due to increased communications.

Processing Environments

A summary of the processing environments sought in the advertisements is presented in Table 2. A review of the table shows the highest demand for the UNIX environment (315 listings, which is over 20% of the total). A distant second was the AS/400 environment (172 listings). Environments with over 100 listings included Windows (138 listings), OS/2 (118), Client/Server (107) and IBM mainframe (103). Environments with at least 50 listings include VAX (96), LAN (76), GUI (66), PC (63), DOS (60), and Tandem (56). Taken together, it seems like the PC area contains the hottest processing environments. Fitting in the PC area are UNIX, PC, GUI, Windows, DOS, OS/2, Client/Server, PC, LAN and Windows NT environments. This PC area included 1009, or over 65%, of the total 1536 processing environment listed. AS/400 and IBM mainframes still retain a significant share of the processing environments with 265, or 18%, of the listings.

Trends show several of the processing environments with increases over the three years. The client/server and Windows environments seem to have shown large steady increases in listings over the three years. Although not as large in numbers, GUI seems to be steadily increasing also. Also, Windows NT took a large jump in listings in 1995. This seems to coincide with its rise in popularity as a client/server operating system since its introduction in 1994. All of the increasing processing environments seem to be in the PC area and point to an increasing need to train graduates in these environments. Finally, the AS/400 environment showed steady increases over the three years. This seems to indicate that the AS/400 has a large installation base that still requires personnel to maintain those systems.

Three environments seem to be in a decreasing trend. These include HP, Tandem and OS/2. HP (Hewlett Packard) and Tandem seem to be caught in the general trend of decreasing midrange and mainframe computers (although the AS/400 seems to be bucking this trend as seen in the previous paragraph) and, therefore, these sites have a decreasing need for personnel listings. OS/2 seems to have suffered from the Windows trend, a lack of software development for the environment, and general IBM-related problems.

Software Skills

Table 3 presents a summary of the software skills listed in the advertisements. A review of the table shows that C/C++ and COBOL are listed in more advertisements (376 and 370, respectively) than any other software skills. It is obvious from the table that COBOL is not dead and that C/C++ has gained an equal stature with COBOL as the software skills of the 1990's. Together, these two software skills represented over 25% of the total listings. Other major software skills in demand with at least 147 or 5% of the listings include DB2 (301 listings), CICS (271), Oracle (241), SQL (178), IMS (159) and Powerbuilder (155). The software skills seem to be split between those dealing predominately with the mainframe environment (COBOL, DB2, CICS, SQL and IMS) and those dealing with predominately with the PC and client/server environment (C/C++, Oracle and Powerbuilder). Quite possibly the reason some of the mainframe environment software skills are still in high demand is that many of them (e.g. COBOL, DB2, CICS and SQL) are being ported down to the PC and client/server environments, which may prolong the need for those software skills.

As could be expected, the upward trends in software skills revolve around the PC and client/server environments. Those software skills that seem to be increasing in listings include: C/C++, Novell, Oracle, Powerbuilder, SAP, Smalltalk, Sybase, and Visual BASIC. Software skills that seem to be on the decline include: FOCUS, IDMS, IEF, IMS, and NATURAL. Most of these seem to be in the fourth generation language (4GL) and data base areas for mainframe environments (although some of them are being ported down to PC environments).

CONCLUSIONS

Several conclusions can be made from the results of this study regarding how well we are preparing our students for the job market. First, the age of the PC and client/server environment is here. This means that there will be many more jobs in this market in the future. Anyone entering the job market, whether recent graduates or experienced IS professionals, will match employers needs better if they are qualified for these environments. This means experience in the client/server, PC, Windows and GUI environments and software skills (C/C++, Novell, Oracle, Powerbuilder, and visual BASIC to name a few) in those environments will increase one's marketability.

Second, COBOL as a software skill is alive and kicking. Demand for COBOL skills is strong and has actually increased in the past year. Those college and university programs that are using COBOL as the teaching tool for programming seem to be giving their graduates a marketable skill. Students that can attain skills in both COBOL and C/C++ will probably be the most marketable, as reflected in the software skills in job listings.

Third, the title of programmer/analyst is the predominant job title. Usually, this type of job requires some knowledge of programming and systems analysis and design skills. We must make sure our graduates have a good understanding of both of these important, fundamental subject areas. Although other areas, such as Decision Support Systems, Expert Systems, 4GLs, etc., may be more fun to teach, the knowledge does not seem to be transferable to skills that are reflected in IS want ads.

TABLE 1
JOB TITLES

Jan Totals	Jan 93	Jan 94	Jan 95	Job Titles	Jul 92	Jul 93	Jul 94	July Totals
19	4	9	6	Application Programmer	3	4	8	15
13	6	5	2	Architecture Specialist	0	3	1	4
35	9	11	15	Consultant	16	14	17	47
68	25	18	25	Data Base Administrator	7	13	11	31
13	9	3	1	EDP/IS Auditor	0	0	0	0
11	1	3	7	Object Oriented/Data Modelers	2	1	1	4
149	53	51	45	Programmer/Analyst	38	22	43	103
11	4	0	7	QA Tester	0	0	0	0
10	0	2	8	Security Administrator	0	1	2	3
48	16	25	7	Software Designer/Engineer	5	17	26	48
14	6	4	4	Support Specialist	3	0	3	6
35	14	11	10	Systems Analyst	17	7	6	30
14	6	3	5	Systems Engineer	11	2	4	17
28	11	8	9	Systems Programmer	10	2	4	16
11	4	2	5	Technical Specialist	0	1	8	9
17	5	4	8	WAN/LAN/Network Specialist	2	4	0	6
496	173	159	164	Totals	114	91	134	339

TABLE 2
PROCESSING ENVIRONMENT

Jan Totals	Jan 93	Jan 94	Jan 95	Processing Environment	Jul 92	Jul 93	Jul 94	July Totals
112	30	34	48	AS/400	20	18	22	60
81	9	32	40	Client/Server	3	12	11	26
10	4	6	0	DEC	7	6	4	17
43	17	12	14	DOS	4	6	7	17
38	13	9	16	GUI	3	10	15	28
15	10	0	5	HP	4	0	3	7
59	23	15	21	IBM Mainframe	13	12	19	44
44	20	9	15	LAN	6	13	13	22
77	32	25	20	OS/2	15	18	8	41
37	6	10	21	PC	6	14	6	26
34	19	9	6	Tandem	13	1	8	22
207	74	44	89	UNIX	33	39	36	108
56	21	14	21	VAX	14	14	12	40
16	2	5	9	WAN	2	6	4	12
92	25	32	35	Windows	12	15	19	46
37	4	7	26	Windows NT	0	1	8	9
29	15	8	8	X-Windows	5	5	4	14
987	324	269	394	Totals	160	190	198	549

TABLE 3
SOFTWARE SKILLS

Jan Totals	Jan 93	Jan 94	Jan 95	Software Skills	Jul 92	Jul 93	Jul 94	July Totals
38	20	6	12	ADABASE	17	7	10	34
27	12	11	4	Assembler	5	5	1	11
42	15	8	19	CASE tools	10	11	9	30
162	65	33	64	CICS	42	28	39	109
209	78	51	80	COBOL	51	50	60	161
249	53	104	92	C/C++	30	55	42	127
171	78	20	73	DB2	45	42	43	130
17	15	0	2	FOCUS	10	5	4	19
18	14	4	0	IDMS	8	0	7	15
25	20	0	5	IEF	12	4	4	20
93	49	22	22	IMS	26	14	26	66
20	16	4	0	NATURAL	18	3	4	25
48	10	13	25	Novell	1	11	11	23
151	36	38	77	Oracle	19	34	37	90
8	3	0	5	PL/1	8	7	5	20
108	25	34	49	Powerbuilder	1	19	27	47
50	14	15	21	RPG	16	4	13	33
30	0	13	17	SAP	0	4	6	10
23	10	10	3	SAS	4	6	4	14
43	5	15	23	Smalltalk	0	5	12	17
95	34	23	38	SQL	35	24	24	83
73	23	11	39	Sybase	12	18	26	56
80	8	32	40	Visual BASIC	0	6	15	21
1780	603	467	710	Totals	370	362	429	1161

Informatics and Information Systems Education in the Netherlands

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ABSTRACT

This paper describes the main initiatives taken in the Netherlands between 1960 and 1995 with respect to Informatics and Information Systems Education at various educational levels. It reports the main findings of a recent audit of the 16 Informatics and 18 Information Systems college programmes by an Audit Committee established by the Dutch Minister of Education. The committee's report showed that there is a wide spectrum of programmes, but also that there are some gaps and anachronisms. It proposed changes which will affect all programmes and colleges. Not all recommendations were welcomed by everybody.

0. Introduction

To enable readers to appreciate the debate in the Netherlands about our Informatics and Information Systems Education and the recently proposed changes, the initiatives between 1960 and 1995, which had a lasting and significant impact on the profession, are briefly described. These initiatives were taken at various educational levels (secondary, vocational, and university) and affected non-regular (private) education in the form of occasional courses as well as regular education in publicly-funded schools. In 1993/94, 16 Informatics programmes and 18 Information Systems programmes at 24 'Hogescholen' (hereinafter called 'Colleges') were audited by an Audit Committee established by the Minister of Education. The committee's report showed that there is a wide spectrum of programmes at Colleges, but also that there are some gaps and anachronisms. It proposed changes which will affect all of these 24 Colleges and probably several other institutions. For example, the Committee proposes that most of the programmes for Informatics should merge with programmes for Information Systems. Although the members of the Audit Committee were drawn from various sectors of society, not all recommendations were welcomed by everyone outside the Committee. Nevertheless, several recommendations found widespread support. As a starting point for a debate at ISECON'95, the issues that did or did not find support will be outlined.

1. Initiatives taken in the Netherlands with respect to Informatics and Information Systems Education (1960-1995)

1.1 Administrative Automation Education Programme (AMBI)

At the end of the 1950s, a group of public accountants took the initiative to found the Dutch Study Centre for Administrative Automation. In the early 1960s this study centre created a suit of modules that finally resulted in a non-regular course called AMBI and several other courses. AMBI (which stands for Automation and Mechanization of Managerial Information Processing) was a course at the Dutch College level, which is approximately equivalent to the German *Fachhochschule*, or British Polytechnic. The other courses were at a lower level, and most were targeted at distinct abilities such as programming a certain computer or in a certain computer language (later: a programming language).

The names of the Study Centre and of the AMBI reveal a bias towards the managerial processes in an organization. The focus is on administrative and managerial information, and the initiators were management professionals. The consequences of this feature of the Dutch setting will be discussed further later. Yet it cannot be denied that the Centre and AMBI set the example for informatics and information systems education in the Netherlands. Naturally this programme, which still attracts many students, has been revised and updated several times since. Since the 1980s the standard-setting and the examination of candidates have been split off from the teaching organization.

1.2 Informatics Education Programme (HI)

At the end of the 1960s, a committee initiated by the board of the Centre recommended the establishment of a new 4-year training course within some Colleges in order to meet the need for well-trained informatics professionals. The programme would begin in 1971 in one school, grow to four schools in 1973, and would finally embrace ten schools. The Dutch term *informatica* (German *Informatik*, English *informatics*, French *informatique*) is said in the committee's report (Frielink, 1969) to have been used as early as 1964, by Zoutendijk (a member of the committee) in his professorial inaugural speech.

My own observation is that informatics in the Netherlands was associated from then on with administrative automation. In fact, on the title page of this report, the phrase *Bestuurlijke Informatieverwerking* (Managerial information processing) has been added between brackets to the name of the Study Centre! Applications of information technology (called computers at the time) to production processes and to products fell outside the scope of this initiative.

When, in 1971, (regular) Informatics courses were established within two (and later more) Colleges, they were oriented towards programming for administrative systems. COBOL programming was an essential skill. This programme will be referred to as HI. The implementation of this new programme led to considerable debate between the Schools for Technology and the Schools for Business Administration. Both argued that this kind of education was essentially their field. The dispute was resolved by the Ministry of Education in favour of the Schools for Technology, although the Business Administration schools soon established a variant of this programme (see section 1.3 below).

The committee argued that although it considered that there was also an urgent need for a substantial number of university trained informatics professionals, it was not its function to make recommendations in this area. The committee remarked that there was also a need to provide professionals in specific fields, who would have to cooperate with informatics people in their work, with informatics training. For that purpose, it recommended that the subject of *informatica* should be introduced in the relevant schools at college level, as well as in secondary schools.

At the same time, the programmes for electrical and electronic training in Schools for Technology developed their own specialization in computer technology.

1.3 Information Systems Education Programme (BI)

Another ministerial committee advised the Minister of Education on the need for an Informatics programme in Schools for Business Administration. I was a member of that committee, which completed its work in 1972. It recommended the establishment of a new programme called *Bedrijfsinformatica* (literally Business Informatics, *Wirtschaftsinformatik* in German, *Informatique de Gestion* in French) in some Schools for Business Administration. This programme should be directed not towards programming, but rather to the analysis, design, specification and implementation of business information systems. Hence, these students should know much more about industry, government and business than the students of the Schools for Technology, whom they should see as their partners in developing and implementing these systems. The first programmes started in 1973. These programmes will be referred to as BI.

1.4 Informatics Programmes at University level (I)

In the Netherlands, there was a complete dichotomy between colleges and universities, with respect to programmes, institutional structures, and ministerial supervision. Colleges were overseen by the minister, as are primary, secondary and vocational schools. Universities had a statutory existence. In a sense, it was easier to start a new programme in a college than in a university: it was simply a ministerial decision. In a university it would need the approval of all universities and of the Minister. Moreover, all university specializations (that is: what can be studied as a discipline in a university, and be mentioned on the graduates' diplomas) were listed in the University Statute.[2] Adding a new field was and is not easy, and the Minister of Education certainly cannot do it by decree.

In the years prior to the official inclusion of Informatics as a new field of study, all universities had appointed professors who were lecturing and studying informatics or a similar field, but under another name. Those professors worked within a recognized disciple such as mathematics, *bedrijfseconomie* ('business administration'), medicine, sociology, etc. As a result, more and more graduates who had studied informatics and/or information systems as an option within their field became available. But the number of such graduates still fell far short of the demand for teachers caused by the decision to start informatics and information systems programmes at the college level. Hence, various crash programmes, collective and individual, were set up to update graduates and teachers of other disciplines. Chemistry and languages, for example, had too many graduates compared to the demand at the time and several of these switched to informatics. This put pressure on proposals from some universities (i.e. professors) which wanted to start with an academic informatics programme. It was argued by those opposing such proposals that there was not enough informatics theory available to justify that step. This might be one of the reasons which led the well-known Edsger Dijkstra to say that informatics was a (new) branch of mathematics and nothing else: the intention was perhaps to make it easier to accommodate informatics in the available programmes of that time. It is curious that Dijkstra has been one of the foremost contributors to informatics theory.

1.5 Information Systems Programmes at University level (BIK)

There was a discussion between faculties about who 'owned' informatics, along similar lines to the debate between the colleges. The design-oriented faculties in the Universities for Technology claimed informatics as one of their fields, like machine tooling and aircraft building. The analysis-oriented faculties in the more traditional fields such as medicine, economics, law, or languages, coined terms such as medical informatics or business informatics ('x informatics') to strengthen their claim.

Finally, in the early 1980s, ten years after the start of the colleges programmes, the universities got their informatics and information systems programmes. Informatics was first implemented in the traditional mathematical schools of the Universities for Technology. Of course, there were a lot of other initiatives in other technological programmes of the Universities for Technology, but those would not deliver graduates with the title of *informaticus* (plural: *informatici*, i.e. informaticians).

Several (business) economics faculties grumbled, and wanted to set up a programme for business informatics, but they could not get approval because of the use of the term informatics. The newly formed informatics faculties argued that 'x informatics' was clearly applied informatics and should not be a field of academic study. Of course, most of the economics faculties had set up such a programme as a specialization within one of their current programmes, and the argument against 'applied science' hurt. It was not until after my colleague at that time, Jan van Belkum, coined the term *bestuurlijke informatiekunde* (German *Wirtschafsinformatik*, the English equivalent would be managerial information systems), that the university we worked for at that time, and where we had developed such a programme, was allowed by the Minister to start 'an experimental programme for *bestuurlijke informatiekunde (BIK)* in 1982. This programme is still 'experimental' and the only one in the Netherlands which has its own course for first year students. All other programmes have to comply with the restrictions for the programmes in their 'original' field, e.g. economics or business studies, so that students have to complete the first year course in these fields. Thus there are now many more opportunities to graduate with a good knowledge of managerial information systems or information management, as in my present university, although these graduates are called *bedrijfseconomen* (business economists) or *bedrijfskundigen* (business specialists).

2. Results of an Audit in Colleges of the situation to date

In 1993/94, 16 Informatics programmes and 18 Information Systems programmes, in 24 Colleges, were audited by an Audit Committee established by the Minister of Education. Such Audit Committees have been common in the Netherlands since 1990, for all types of publicly-funded educational institutes. This committee's report (HBO-Raad, 1994) showed that there is a wide spectrum of programmes at Colleges, but also that there are some gaps and anachronisms.

The committee's most striking observation was that the courses suffered from 'isolation', although it also observed some steps being taken in the direction of integration. Indeed, its report was entitled 'From isolation to integration'. The committee observed isolation of teachers, of courses within a programme, of programmes within the school, and of schools within their regions. It observed also that the better programmes and schools were working towards more involvement, cooperation, coordination, feedback and feed forward, exchange, and networking, hence: towards integration. But the rate at which subjects in these courses and programmes have to be updated is a real obstacle to integration. This is one reason why these programmes are different, although they are all called Schools of Informatics or of Information Systems.

In addition to the HI and BI programmes, the committee found some TI (technical informatics) programmes which had grown out the computer technology programmes, as well as a few programmes specializing in the health care sector, the finance sector, geographic and cartographic applications, integrated manufacturing, and communication.

The committee perceived a diversity between the HI programmes, mainly due to the rapid coming and going of technical topics. The problem here was to keep up to date, and to know what topics would disappear without impact and which would be important for the students, bearing in mind also the costly investments which might be involved. Some HI programmes had developed into Software Engineering programmes, some had developed more in the direction of information technological programmes. The orientation, however, was clear: the building of software systems.

The committee observed that some BI programmes were very much like the original concept of the early 1970s: the orientation to the development of financial-administrative systems was still dominant. However, this is understandable since it is not the intention that these business administration schools should cover the whole of business studies. What the committee could not fathom was why, in one of these schools, COBOL programming was still the 'heart of the matter'. The committee said that this is a lower level skill and should not be taught at college level, although the school in question argued that organizations in their region still asked for graduates with that skill, and that one language was as good as another for teaching since the graduates would have to switch to an unknown language when they joined an organization.

Other BI programmes, however, concentrated on analysis and design and had included applications of IT in production processes and sometimes even products. The committee also found programmes that were more oriented towards implementation and organizational change rather than development.

An interesting difference could be observed in the city of Enschede, where one BI programme is oriented towards 'vertical' managerial objectives and a second is oriented towards 'horizontal' office automation. The latter includes multimedia, workflow management, and change management.

Another interesting observation is one I made myself, namely that an Information Resource Management programme at my local college, which had resulted from reconstructing a library management programme, could compete with several of the better BI programmes. Note that this IRM programme is located in a different sector and consequently will be visited by a different audit committee.

As noted above, there were originally two types of programmes: informatics (HI) and business informatics (BI). The committee found that on the one hand several informatics programmes had developed in the direction of information systems, whereas some information systems programmes had many informatics subjects. The committee also found that none of the BI programmes combined an extensive coverage of domain knowledge with a reasonable coverage of IS knowledge (in fact the weight was just the other way around), and that neither of the existing programmes within the Schools for Business Administration offered such a programme.

The committee lists various skills needed to produce good IT applications:
a. skills with respect to adopting and using Information Technology
b. skills with respect to Software Engineering
c. skills with respect to Information Systems Development
d. skills with respect to the particular domain of implementation

These skills correspond with knowledge of
a. information technology and computer systems
b. software systems and their construction
c. information systems and their design and implementation
d. the domain of application

One could draw a programme profile by noting what percentage of the programme is devoted to each of these four fields.

When the two programmes were set up in the early 1970s, the domain of application was assumed to be the administration or managerial processes in an organization. Hence, the HI programme was designed to cover (a) and (b), and the BI programme was constructed to cover (c) and (d). In the meantime, some BI programmes have been extended into (b), and some HI programmes have been extended into (c), while a few have HI concentrated on (a).

The domain of application, (d), could include not only the administration, but in fact could broadly include three fields:
d1. production and service processes
d2. management planning and control processes
d3. products and services.

Each of these domains should be served by (a), (b) and (c).

Since the interaction between changes in (d1) and (d2) cannot be denied nowadays, there is an obvious gap in systems development for (d1) AND (d2). Another gap is software engineering for (d3) and in fact also for (d1), the former being the field of embedded software. The last gap is a programme in (d), supplemented with (c), as mentioned above.

Other observations of the committee, include the following:
* enrolment numbers for HI and BI have been decreasing for the last several years, and are currently half of the peak level at the end of the 1980s. This is a threat, because smaller numbers mean fewer teachers, and fewer with tenure, and this could result in lower quality, a vicious circle;
* industrial managers say they are dissatisfied with the value of the automation function in general;
* industry and government say they need more 'good' people in this field.

To these observations I can add that:
* in general, the image of informatics is indeed negative, with both prospective students and managers;
* prospective college and university students said to me that very few informatics and information systems graduates make it into the top ranks of business or government;
* industrial and government managers said that they are happy with the graduates from their local college (both HI and BI) and that they would appoint more of them;
* the salaries of informatics graduates are only slightly higher than those of informaticians of the same age who were employed by industry or government directly after secondary school, and did non-regular informatics courses after working hours (Berenschot, 1993).

In 1995 the Informatics and Information Systems programmes at Universities will be audited (by a different committee[3]). However some observations[4] can already be made about the university courses:

* industrial and government managers said to me that most university informatics graduates are too academic for the job;
* they prefer to take unemployed biologists, nuclear physicists, etc., who have qualifications at Masters or Ph.D. level, and retrain them in Informatics via non-regular courses;
* BIK graduates generally have a job before graduation and industrial managers say they are quite happy with this type of graduate;
* all but one of the gaps observed at the college level can also be found at the university level.

It is especially this last observation that makes it double interesting to take notice of the recommendations of the College Audit Committee.

3. Recommendations made by the Audit Committee (at College level)

The changes proposed by the Audit Committee will affect all of the 24 colleges and probably several other institutes. In fact, their proposals boil down to reconstructing the HI, cancelling the BI in its present form, and constructing a new type of programme. Some of the cancelled BI programme might merge with the reconstructed HI, and some elements of the BI might become the germ of the new programme. The main problem the committee discovered was the lack of identity of the present BI programme. Their proposals are intended to address this identity problem.

The Committee proposes first of all that most of the programmes for Informatics should merge with programmes for Business Informatics. In terms of the list above: building software systems merges with the development of information systems. It is nowadays a lot easier to build software than it was 20 years ago. Presently available iCASE tools make this integration possible, and consequently desirable, now. The committee gives no details about how far this integration should go. There is evidence that about 10% of the programme is domain specific (d), and this apparently covers more than just management planning and control processes (d2). We will return to this point in section 4.

It also proposes that some of the present programmes for Informatics should be redesigned as programmes for Software Engineering, and that these programmes, except for a few specializing in embedded systems, should cover the full range of subjects (software for production and service processes, planning and control processes, and embedded software in products). A few programmes for Informatics should merge with Computer Technology programmes.

The Committee further recommends that all programmes outside the Informatics or Information Systems field (hence, programmes for business administration, technology, health care, agriculture, transport, arts, languages, etc.) should include Information Systems at least as an option for students.

The Committee also recommends that, in addition to the present Schools for Technology and Schools for Business Administration, a new school (School for Business Studies) should be set up in which students can study a combination of aspects relevant to the implementation of Information Technology in organizations: technology, social sciences (economics, sociology, psychology), analysis and design of systems, and management science. These schools already exist at the University level in the Netherlands, but not at the College level. Most of these recommendations, of course, also have implications for this year's audit of Informatics and Information Systems programmes at Universities.

When BIK programmes (or look-alikes, as explained) within university business administration schools were implemented in the early 1980s, the main focus was indeed on financial-administrative systems. This was reinforced by the fact that several of the courses within these programmes also served as part of MBA programmes for controllers or auditors. The focus has generally remained on financial-administrative systems. A wider scope, including primary processes as well as products and services, would be more appropriate today.

Moreover, the issue in these early BIK programmes, and rightly so at the time, was the proper development of information systems. Other elements were introduced to support that issue: information technology, programming, databases, procedures and methods, security, etc. Today, some of these programmes take a more strategic point of view, but certainly not all programmes have redesigned their contents. This has generated (and still is generating) a lot of heat, since very few faculty members or BA students appreciate an 'academic' course in systems analysis and design. Some have even failed to update their courses, and still present inadequate methods and techniques (such as ERA and SASD, to name two). Methods and techniques are still being used that do not give consistent results when applied by different people and make it very difficult to assess students' work. And we have not even mentioned the issue of development versus packages. Should the classic BIK programmes be combined them with the informatics programmes?

As I said, some of these programmes now take a more strategic point of view. The issues then become those of innovation, of information management and of change management, rather than of systems development. These issues are relevant for both large corporations and small enterprises. Do the classic BIK programmes allow incorporation of these issues?

4. Responses to these recommendations

The committee's report was formally scrutinized and commented on by a number of invited 'respondents'. Although the members of the Audit Committee were drawn from various sectors of society, not all recommendations were welcomed by everyone outside the Committee. Nevertheless, several recommendations found widespread support.

First, the proposal to upgrade the HI programme with information systems development has been generally supported, although several respondents warned that the demand for such graduates would not be great. They point out that fewer systems will have to be 'developed' in the sense of system development of the 1970s. First, packages are available for ever more applications, and secondly, iCASE tools and generators will shift the development work to the organization needing the application. On the other hand, the committee did not present any details of this integration. Several BI programmes now offer more than just methods for analysis and design. Where are subjects such as strategic, tactical and operational information management? Where are change management, legal aspects, internal and external organization, administration, production typology, operations research, logistics? Can a 10% allowance for domain-specific knowledge cover all this?

Secondly, the proposal to establish some Software Engineering Schools was also generally supported, including even the proposal that they cover the full range of subjects (d1, d2 and d3).

Third, the need for a special programme for embedded systems is recognized in some responses (there was one vote against, saying that this is not really a different skill compared with Software Engineering for process support systems), as is the need for some more technically-oriented HI programmes.

Fourth, the need for a more all-round business-oriented programme in which the application of IT is an important element (i.e., the School for Business Studies), is recognized in several reactions. Some responses emphasize the need for people who are able to manage the change caused by the application of IT. Currently, there seems to be too little involvement on the part of too many managers when it comes to managing the application of IT in all its consequences. The implementation is left to the information manager or CIO, but the information manager is not in a position to manage the organizational alignment that is necessary.

A comment by the chairman of the NGI (the Dutch equivalent of the ACM) is worth noting: do not cancel the present BI programmes. This chairman is in charge of a university BIK programme, and although his reaction was aimed at the college report, his response might have been made in expectation of a coming storm. His argument is that information systems analysis and design methods are different for different application domains, and merging this skill with informatics skills would imply that the aim is to deliver a graduate jack-of-all-trades. His argument is to increase, rather than decrease the number of specializations in information systems, because there are so many interactions between the application of IT and the domains of application. This question is considered further under point five below.

I think there are other arguments in favour of a BI programme. But let me begin by specifying what kind of BI programme I have in mind. For ease of reference, I repeat the four fields mentioned in chapter 2:

a. information technology and computer systems
b. software systems and their construction
c. information systems and their design and implementation
d. the domain of application

My ideal BI programme would be one with about 50% of the programme taken from field (d) and about 10% each from fields (a) and (c), but nothing from field (b) (although some material might be covered under (a)). This adds up to 70%, leaving another 30% to be specified. My ideal BI programme would fill this in with innovation management, change management and information management, in roughly equal measure. Some existing BI programmes do deal with these subjects, and it would be a loss if those BI programmes were to be cancelled. It is possible that the audit committee had such a programme in mind when it proposed the new Business Studies programme.[5]

The fifth element of the respondents' comments was to agree that more students should have the opportunity to study the consequences of IT for their particular domain. Nobody was against this, but there is an issue that is not mentioned in the report. The interaction between a domain and IT is not the same for every domain. For example, the interaction between medicine and IT is such that IT can be very useful in medical processes (this field is called Medical Informatics), but there is no use for medicine in IT processes. With ethics the interaction is the other way around. IT is not very helpful for ethics, but ethics has a lot to say about IT (this field is called Ethical Computing). With law we find mutual interactions: IT can be very helpful for law (this field is called Legal Informatics), but law can also be very helpful for IT (this field is called Informatics Law). In languages we find a similar situation: language knowledge applied to IT (the NIAM method is one result) and IT applied to languages problems (Linguistical Informatics). We see a similar double interaction in the arts, but not in the sciences. In economics we have the application of IT to the organization (business information systems and embedded systems) and the application of economics to information problems (information economics).

Finally, one of the issues mentioned often, but outside the scope of the committee, is the need for re-education and retraining of working professionals. Could colleges provide courses for working professionals? And more directly: could they provide them at times other than the usual daytime courses? The issues above could serve as a starting point for debate at ISECON'95.

5. Literature

Berenschot, 1993: *Salarisonderzoek* (Salary investigation) as quoted by Mrs. A.E.N. Hacquebard; *Maandblad Informatie*, 36, 11 (Nov. 1994), p. 646

Frielink, 1969: *Opleiding Informatica* (Informatics Education), Report of the Commission on "Opleiding van deskundigen voor Automatische Informatieverwerking" (Chaired by Prof. A.B. Frielink); Het Nederlands Studiecentrum voor Administratieve Automatisering (Bestuurlijke Informatieverwerking), Amsterdam

HBO-Raad, 1994: *Van isolement naar integratie* (From isolation to integration). Eindrapport van de visitatiecommissie informatica-opleidingen; Voorlichtingsdienst HBO-Raad, Den Haag

6. Notes

1. The author is a member of advisory boards of Informatics and Information Systems Schools of two Dutch *Hogescholen* (Colleges of advanced education, similar to *Fachhochschulen*, or *Polytechnics*). This paper was written as a personal note.

2. Presently, both 'hogescholen' and universities are brought under the same new regulation, resembling the University Statute.

3. Also the scope of the university programmes audited will be smaller.

4. An informed colleague reacted that these remarks were more like a cartoon and that employers on the whole were reasonably satisfied with the graduates, but that indeed more attention could be paid to project experience, communicative skills, real life cases, and topical subjects.

5. That's correct, said my informed colleague recently.

"Developing Your First Expert System": A Multimedia Aid

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ABSTRACT

The interactive multimedia market is expected to grow to about $25 billion by the end of 1995 [1], and a major market for multimedia is education and training. In the new College of Integrated Science and Technology (CISAT) at James Madison University (JMU), multimedia has been identified as a strategic supporting technology that will be integrated throughout the curriculum. The first multimedia program that is being used as an instructional module in CISAT is described in this paper. The multimedia aid is called "Developing Your First Expert System". Over 200 students at George Washington University and James Madison University have used this program, and the student feedback on the use of the program has been very positive. Their enthusiasm has led to the CD-ROM implementation of the "Developing Your First Expert System" multimedia aid which has been distributed worldwide. This aid could be used in an introductory expert systems course or as a module in a MIS/Survey of Information Technology course.

1.0 The Planned Use of Multimedia at CISAT

The new College of Integrated Science and Technology (CISAT) at James Madison University is involved in using interactive multimedia at three levels: presentation, individual, and programming. At the presentation level, CISAT is developing interactive lecture material to complement traditional teaching approaches. Curriculum content is prepared using multimedia software tools and presented to students in the classroom. Large screen video and data projection along with sound and animation presents complex concepts in a manner more easily understood and exciting than writing on chalk boards. Faculty have a full range of digitization tools to work with: color scanners, video capture from laser disk, tape and live feeds from cable, satellite, or video cameras.

Individual interactive multimedia typically centers around a one-on-one experience with the computer. The college is developing instructional modules which can be used in several different environments. During lecture or class time, professors will demonstrate the instructional module, with the presentation level approach. It is after this period when individual interactivity becomes important. In addition to reviewing notes taken from class, students simply access the same instructional module presented in class. The access can either be via lab computers, diskettes, or network servers. The student can review the material whenever and as often as they need to completely understand the material.

The above mentioned approaches to interactive multimedia are fairly common across the industry. The College of Integrated Science and Technology feels that the programming level sets it apart from other approaches. Multimedia development tools such as ToolBook, IconAuthor, Director, Astound, and others make it easy for the user to develop interactive presentations and instructional modules. However, the concepts of object-oriented programming are typically not stressed. Most users are not experienced programmers and do not feel comfortable venturing into event-driven elements and logic constructs. The College of Integrated Science and Technology approach is to bring out the language stressing an understanding at the beginning of the learning curve. It is this language that provides the power of interactive multimedia and represents a true evolution and transition in the area of computer programming. The programming language in all three of the previously mentioned software tools, stress their near "English-like" dialog.

While the College of Integrated Science and Technology feels that interactive multimedia for faculty represents great opportunities to present information to groups as well as individual students, the tools are not just for them. In the hands of students, these tools offer the student an opportunity to communicate much beyond traditional methods. The College instructs and expects the student to use these tools for a variety of applications. At the minimum, students are required to use multimedia tools for presentations. However, the College sees additional uses of these technologies. One such example is the "electronic" term paper. Instead of turning in pages of the traditional term paper, students prepare the paper on the computer. They then use the interactive development tools to create a set of files that is reviewed by the faculty. Several such projects have already proved successful, such as an interactive multimedia term paper describing speech understanding. Additionally, the programming level can be used as an exciting alternative to traditional character-based code development. Dice on Dice is a JMU student and faculty collaboration, where an analysis of dice statistics was demonstrated. However, instead of writing the program in BASIC, FORTRAN or other character-based languages, they developed it in an interactive multimedia language. With the power of object-oriented and event-driven scripting language and the graphics and animation of the multimedia software, this program indeed demonstrates the advantages of interactive multimedia programming.

2.0 The Innovative Use of Expert Systems in the CISAT Curriculum

In Thomas Stewart's [2] article, "Brainpower", he writes:

"Most companies are filled with intelligence, but too much of it resides in the computer whiz who speaks a mile a minute in no known language, in the brash account manager who racks up great numbers but has alienated everyone, or in files moved to the basement. Or it's retired and gone fishing. The challenge is to capture, capitalize, and leverage this free floating brainpower. Every company depends increasingly on knowledge--patents, processes, management skills, technologies, information about customers and suppliers, and old-fashioned experience. Added together, this knowledge is intellectual capital."

The problem that Mr. Stewart addresses is the "real-world" issue of the way we train people to use knowledge--how we mix, match, and focus our knowledge. The traditional scientific and technical curriculum produces focused specialists, trained to think in a "vertical" manner. This is inevitably reflected, as Stewart points out, in the hierarchical construction of organizations and the way people operate in the workplace.

According to Wilcox [3], we have not developed satisfactory fundamental paradigms in a world that is increasingly interdisciplinary. We must re-think the entire enterprise of higher education or American schools will go the way of many American industries that have faded with the waning of the 20th century.

In the College of Integrated Science and Technology (CISAT) at James Madison University, these deficiencies in the educational process have been recognized. The mission of CISAT is to develop students who are context-sensitive, collaborative problem solvers in science and technology. The B.S. in Integrated Science and Technology program is geared to produce broad-based thinkers who integrate the core disciplines and specialties in science and technology. Accordingly, CISAT encourages each student to take an analytical and strategic approach to problems and issues, to be a team player, and to become an internationalist with a keen understanding of the globalization process. Team-teaching, a hallmark of every course, fosters these viewpoints. As a result of this curriculum, the CISAT student takes equal doses of a triad of sciences, business and management, and computer technology.

In addition to multimedia, expert/knowledge-based systems (KBS) are being used as one of the integrative strategic supporting sciences that will glue this innovative curriculum together. Knowledge-based systems [4-6] have been identified as a unifying thread in the CISAT curriculum as knowledge technology will affect all areas of study in the future, including energy, environmental systems, manufacturing, instrumentation and measurement, biotechnology, transportation, health sciences, and other CISAT strategic sectors that will be offered in the junior and senior years. Expert systems are computer programs that emulate the behavior of an expert in a well-defined domain of knowledge. Knowledge-based systems are more general programs, as compared with expert systems, that provide knowledge, but where there may not necessarily be sources of expertise for that particular domain.

In the freshman and sophomore years, knowledge-based systems will be sprinkled throughout the Analytical Methods and Issues courses. In the Analytical Methods courses (taken in the first four semesters), the student is introduced to the "vocabulary and general concepts" of knowledge-based systems, followed by "KBS building skills" and then "KBS using/application skills". In the Issues courses where the themes of "The Environment", "Health", "The Human Brain and Genetic Engineering", and "Manufacturing at Work" are used, applications of expert and knowledge-based systems in each respective area are shown to the students. Techniques for knowledge elicitation and acquisition are conveyed to the students to help them in team building, organizational behavior, and group projects.

In the junior and senior years, the students take a number of courses in "Strategic Sectors" whereby knowledge-based system applications are scattered throughout these areas. For example, in the environmental systems strategic sector, an expert system as a spill and release advisor and an expert system used in hurricane tracking are shown and are manipulated by the students. In the manufacturing strategic sector, expert system applications in scheduling, computer-integrated manufacturing, and product design will be used by the students. As a result of this effort, a library of expert systems applications in the various strategic sectors is being built for easy access and use by the student.

A strategic sector in "Knowledge Management" at the junior and senior level also exists in order to provide additional information in this area. Courses dealing with "intelligent systems", "information systems design studio", "hypermedia", and "emerging knowledge technologies" are typical courses that comprise this sector.

CISAT at James Madison University has recognized the importance of knowledge technology and knowledge management and is integrating these concepts throughout its undergraduate curriculum. Interactive multimedia is playing a role in helping the students learn about knowledge management and expert systems, as will be discussed next.

3.0 Use of Interactive Multimedia Aids to Help the CISAT Students Learn About Expert Systems

In order for educational systems to make increasing use of systems that acquire, restructure, and distribute knowledge, knowledge-based systems will play a vital role. New and innovative techniques must be developed that will allow the rapid and inexpensive design, production, and distribution of instructional modules and packages. Knowledge-based systems will be useful in bringing new and efficient processes into the analysis and design of the knowledge structures that eventually will find themselves programmed into an instructional module. Knowledge-based systems will be used in elementary and secondary schools. Interactive videodisc technology is now being used to teach history, geography, science, and other subjects. Knowledge-based systems could be linked with this videodisc technology to enhance education by tutoring students in selected subjects. For example, an expert system could be constructed for chemistry, and then simulated chemistry experiments could be shown via videodisc technology. An intelligent tutoring system would be able to adjust its questioning and tutoring according to the student's level of understanding. Intelligent tutors are now used in teaching foreign languages, geography, and other subjects. The main problem in constructing intelligent tutors is that it typically takes 5 person-years to incorporate 1 year of instruction in an intelligent tutoring system. As this technology matures and shells are developed to facilitate the construction of these tutors, more intelligent tutoring systems will be used in the classroom to supplement the teacher's lessons.

In order to move closer to this goal of using interactive aids to help students learn various subjects, CISAT has begun to develop interactive multimedia aids to help students learn about various modules of study associated with their curriculum. The first interactive multimedia aid that has been developed is called "The 7 Week Classroom Quick Guide to Developing Your First Expert System Prototype" [7,8]. This multimedia aid is geared for helping the student learn the knowledge engineering life cycle associated with developing expert systems. This aid is being used in connection with the freshman Analytical Methods course to help supplement the lecture material on expert systems.

The first version of the system was built using the COMPEL multimedia software on a 486 Dell computer. It includes graphics, animation, text, digitized photos, and sound relating to expert systems applications and interviews with leading authorities in expert systems. This interactive multimedia aid includes a week by week description, with assignments, on how to build an expert system. The major topics include an overview of expert systems development, problem selection, knowledge acquisition, knowledge representation, knowledge encoding, knowledge testing and evaluation, implementation and maintenance, student-developed expert systems, and references.

This multimedia aid was used by the ISAT (Integrated Science and Technology) freshmen while learning about expert systems in a module during their Analytical Methods course. About 80 students used the multimedia aid from 1 to 3 hours, and then wrote a critique of the system. Their general comments for improvement were as follows:

o the system needed to include less text and more voice, graphics, animation, and video;

o instead of merely reading the text on the computer screen, a voice-over capability should be an option;

o spelling errors should be corrected;

o more navigational controls on the part of the user should be incorporated into the system.

Overall, the students seemed to enjoy the use of this multimedia aid to help them learn about expert systems technology and knowledge engineering. They enjoyed the self-paced, interactive style as opposed to the "traditional lecture format" used in most classrooms. By allowing the students to use this multimedia aid, the students were able to learn the "basics" of expert systems technology outside of the classroom, and then more lively, enriching discussions were generated during the class time itself (such as covering case studies, war stories, anecdotes, etc. about expert systems projects).

After receiving the comments from the students at the end of the Spring 1994 semester, we incorporated their feedback into developing the second version of this multimedia aid over the Summer 1994. We decided to use Astound instead of Compel due to improved capabilities for user navigation through the system and enhanced development features like spell checking, timelining, and others. The second version of this system was completed in three months in time for the beginning of the Fall 1994 semester, where students used this multimedia aid to help them in refreshing their memory about expert systems or allowing the new entering class of students to become familiarized with expert systems technology. This system is being used over the PC network at both James Madison University and George Washington University. The second release of the system has about 180 slides comprising about 75 megabytes. Comments from the students were incorporated into the final version of this multimedia aid, and it is now available via CD-ROM for distribution through the non-profit organization, International Society for Intelligent Systems (PO Box 1656, Rockville, Maryland 20849). Already, organizations from over 14 countries have purchased this CD ROM.

3.1 Lessons Learned: Development and Deployment

Several important lessons were learned from the development and deployment of the "Developing Your First Expert System" CD ROM. From the development side, the following lessons learned were:

o the university should provide an infrastructure (like a Center for Multimedia/Integrated Learning Resources) where multimedia specialists can work with the faculty, and the faculty can also take tutorials/workshops to learn the multimedia authoring packages:

o beware of the limitations and concealed bugs of some of the multimedia authoring packages (for example, one of Astound's limitations is no automatic bookmarking feature);

o proper project management techniques are extremely helpful in moving the multimedia project forward (e.g., schedules, milestone charts, weekly meetings, etc.);

o incorporating student/user feedback is crucial during the development process (over 200 students critiqued the aid--wrote formal reviews--contributing to improved versions of the system; we incorporated their comments into the new versions of the system).

From the deployment perspective, the following lessons were learned:

o you might find new bugs when the system is being ready to be deployed (for example, there was a bug in an earlier release of Astound that wouldn't let you copy the run-time program onto a CD--unfortunately, we weren't told about this);

o some of the lower end multimedia authoring packages are not powerful enough for your needs (you may need to go with Authorware Professional, Director, IconAuthor, Mediascript, etc.);

o double-check to make sure that the CD ROM produced as the pre-master runs on your machine (and that you also do some testing/quality control);

o initial feedback is great enthusiasm for the "Developing Your First Expert System" aid and students who used it more, performed better on the midterm than those who didn't.

4.0 Summary

Our first encounter with using interactive multimedia as an instructional module in the CISAT curriculum has been very successful. The students have been pleased with this multimedia aid for learning about expert systems development, and in turn, they are developing presentations using multimedia. This system has also sparked the interest of the CISAT faculty who are eager to develop instructional multimedia modules relating to their disciplines. We also feel that through wider distribution of this system via CD-ROMs, other college and high school students will be more easily able to learn about emerging technologies like expert systems. We are currently developing a multimedia program to help students learn about knowledge acquisition methods. This is being developed using Macromind's Authorware Professional.

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GRAPHICAL CLASS AND INSTANCE RULES IN AN OBJECT-ORIENTED ENVIRONMENT

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ABSTRACT

In this paper a graphical representation of rules is proposed. The graphical rules are formulated based on extended Entity-Relationship diagrams. We identify and discuss two types of graphical rules: class graphical rules and instance graphical rules. The syntax and semantics of both types of graphical rules are discussed. The graphical rules can contain object-oriented code in addition to graphical diagrams. The methods of integration of diagrams and object-oriented code are described.

1. INTRODUCTION

Rapid prototyping can be very helpful in the development process of many systems [14]. Rule-based programming [1, 5, 6, 12] is considered a good candidate for rapid prototyping because of the relatively simple procedure of inserting and deleting rules for the prototyped system. At the same time, existing rule-based programming languages do not support encapsulation and modularity and, as a result, it seems quite difficult to develop large rule-based systems [13]. One way to take significant advantage of rule-based programming is to integrate the rule-based system with an object-oriented language [10] or database language [7].

In this paper we describe an object-oriented environment that includes database primitives and show how graphical rules can be integrated into such an environment. The approach is an extension of our previous work [3, 4, 8, 9], where we proposed the use of graphical specifications based on an extended Entity-Relationship (EER) model and showed how such graphical specifications can be described in an object-oriented environment.

We identify and discuss two types of graphical rules: class graphical rules and instance graphical rules. A preliminary discussion of these two types of graphical rules appear in [16]. The graphical rules in [16] were based on undirected graphs. In this paper, however, the graphical rules are based on directed graphs. Here, we also develop a more precise description of syntax and semantics of the graphical rules. The syntax of graphical diagrams is defined by an EER meta-model. The semantics of graphical diagrams is described by the graphical rules themselves (meta-rules). A Smalltalk database library is assumed for the parts requiring direct object-oriented code.

The paper is organized as follows. In the next section, the description of two types of graphical rules is provided. In Section 3 the processing of graphical rules is discussed. In Section 4 the syntax of graphical rules is defined using an EER meta-model. The semantics of graphical rules is discussed in Section 5. The representation of graphical rules is described in Section 6. The Summary presents some conclusions.

2. CLASS AND INSTANCE GRAPHICAL RULES

In this section we describe class and instance graphical rules. We will give an example of each type of graphical rule and describe how it is processed.

A *class rule* is a rule that is applied to a class and consists of three elements: base class name (CN), left hand side (LHS) and right hand side (RHS). The LHS consists of a non-empty sequence of condition components. Each condition component is either a condition diagram (CD) or condition text (CT). In order to integrate efficiently these components, we allow them to share the same variables. The LHS element returns a single boolean value which determines if the RHS is to be executed. The RHS element describes actions that are executed when the rule is fired. These actions consist of a sequence of action components. Each action component is either an action diagram (AD) or action text (AT). The AD and AT components can share the same variables.

An *instance rule* consists of similar elements: base class name (CN), left hand side (LHS) and right hand side (RHS). The structure of the LHS of an instance rule is the same as the structure of the LHS of a class rule. The LHS element of an instance rule returns a boolean value for each object in the CN class. This boolean value determines if the RHS is to be executed for that particular object. The RHS element for an instance rule is also similar to the RHS element of a class rule. The only difference is that here it is executed for each applicable object. Both condition diagrams and action diagrams are based on EER diagrams [3, 9].

2.1 Extended Entity-Relationship Diagrams

The EER model views the world as consisting of objects (entities) and relationships among those objects. Objects and relationships are classified into object sets and relationship sets respectively. An EER object set has an associated EER class. Such a model brings together the object-oriented concept of a class and the database concept of an entity set. The EER class is a template which allows the creation of instances (objects). The EER class can have a parent class, as this environment supports inheritance. The objects created using the EER class are stored in the associated object set, similar to the manner that entity sets contain their entities. Objects have data (instance variables) that are referred to as *attributes.*

Figure 1 shows an EER diagram which describes part of a Student Registration system that includes two object sets Student and Section, and two relationship sets Enrolled and Waitlisted.

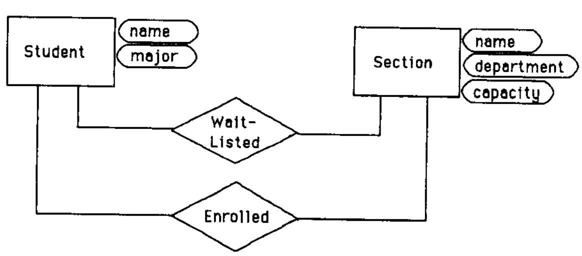


Figure 1. An EER model representing a part of a Student Registration System

An object exists in the real world and is distinguished from other objects. An object set is a set of objects that have some common properties. For example, in Figure 1, the object set Student contains all students in the Student Registration System.

A relationship is a meaningful connection among objects. A collection of relationships pertaining to the same object set can constitute a relationship set. For example, in Figure 1, the relationship set **Enrolled** connects the object sets Student and Section. The subclass/superclass relationship sets for the EER model are maintained in a manner similar to other relationship sets.

The object sets are represented graphically, as in typical ER diagrams, by a rectangle containing the name of that entity set. The relationship sets are represented graphically by a diamond box containing the name of that relationship set. Superclass/subclass relationships are represented as a triangle "pointing" to the superclass.

2.2 Condition Diagrams

We construct condition diagrams by converting the EER model into a directed acyclic graph and attaching conditions and variables to the object sets. In order to convert the EER model into a directed acyclic graph we identify a *root* object set and make all icons for relationship sets directional. The *root* object set is shaded as in Figures 2 and 3. In Figure 3A the arrow of the directed relationship set **Enrolled** points to the output object set, **Student**.

The selection conditions are indicated by the condition box. Conditions can be either attribute conditions or set conditions. Attribute conditions are represented graphically by attaching a condition box to an attribute icon as shown in Figure 2A. Set conditions are represented graphically by attaching a condition box to an object set icon.

Variables can be either attribute variables or set variables. Attribute variables are represented graphically by attaching the variable box to an attribute icon. Set variables are represented graphically by attaching the variable box to an object set icon as shown in Figure 2A.

2.3 Action Diagrams

Action diagrams can be more complex in the sense that they also can contain updates. The updates are indicated either by the update box as in Figure 2C or by deletion or insertion indicators. Deletion indicators are represented graphically by filling the icon of the object or relationship set with characters "D" as shown in Figure 3C. Insertion indicators are represented graphically by filling the icon of the object or relationship set with characters "I".

Let us consider a rule:

Rule 1: "If there are less than 5 computer science majors, then change major from 'CS' to 'none' for all these students".

This is the class rule because the LHS component is evaluated once for the object set. Class rules are designated by a double bar on the left side of the base object set, Student in this case. The LHS components can be represented in Figure 2A (condition diagram) and Figure 2B (condition text). In the condition diagram, the set of students who satisfy the conditions is selected and the result is stored in the variable labeled VARa.

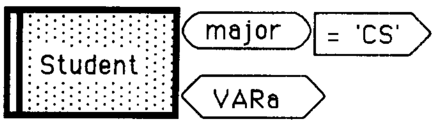


Figure 2A. Condition Diagram for **Rule 1.**

The boolean value is computed for the condition text by comparing the count of VARa with the number 5. The operator *count* is defined for all sets of objects.

^VARa count < 5

Figure 2B. Condition Text for **Rule 1.**

The RHS of the rule 1 can be specified by an action diagram in Figure 2C. In the action diagram, all students who are currently computer science majors are identified, and the property 'major' takes the new value 'none'.

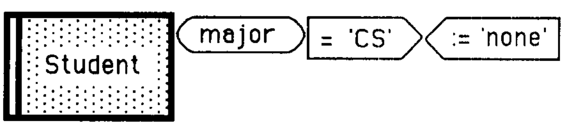


Figure 2C. Action Diagram for **Rule 1.**

Since the RHS of this rule can be specified completely by the action diagram, there is no action text for this rule. Let us consider another rule:

Rule 2: "If any section has at most 3 students enrolled, then cancel the section" .

This is an instance rule because the LHS is evaluated for each object in the class Section. The LHS components can be represented in Figure 3A (condition diagram) and Figure 3B (condition text). In the condition diagram, the set of students who are enrolled for a given section is selected and the result is stored in the variable labeled VARa.

The boolean value is computed using the condition text by comparing the count of VARa with the number 3.

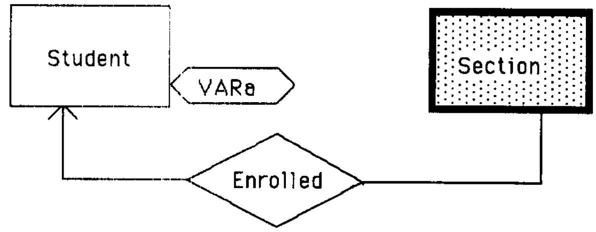


Figure 3A. Condition Diagram for **Rule 2.**

^VARa count <= 3

Figure 3B. Condition Text for **Rule 2**

The action diagram corresponding to the RHS of the rule 2 is shown in Figure 3C. In it, all sections satisfying the LHS condition are deleted from the system. The action text for this rule is not needed.

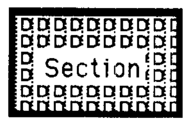


Figure 3C. Action Diagram for **Rule 2.**

3. PROCESSING OF GRAPHICAL RULES

The graphical rules can be translated into object-oriented code (e.g. into Smalltalk code) and executed using an inference engine. In order to simplify the translation we will assume that the object-oriented programming environment will contain a library of database abstractions. In this section we will shortly describe this library. Then we will show how graphical rules are translated using Rules 1 and 2 as examples.

3.1 Library of Database Abstractions

The Library of Object-oriented Database Abstractions (LODA) was written by us in the object-oriented language, Smalltalk [11], but can be easily expressed in other object-oriented programming languages. The library is based on Extended Entity-Relationship model abstractions.

Specification of queries in an EER database involves use of the *selectWhere, selectAll, relate* and *relateUsing* operators. The selectWhere message selects those objects from the set that satisfy some condition. For instance, in order to select all faculty whose degree is PhD, we might invoke the message

Faculty selectWhere:#('degree' '=' 'PhD').

This operator builds a new set from an existing one with a (usually) smaller collection of objects.

The selectAll message selects all of the objects from the set. For instance, we can select all faculty by invoking the

message
    Faculty selectAll.

This operator also builds a new set from an existing one. There are cases (discussed in Section 4) where the receiver of the "selectAll" operator is a single object, rather than an object set. In this case, the operator returns a set with the single object.

In order to relate objects using a specific relationship set, one specifies the object set and the connecting relationship set. For instance, we may want to relate the objects in Faculty using the relationship Teaches to obtain a subset of Student. We would call this operation by:
    Faculty relateUsing:Teaches.

Another relationship is defined using the subclass/superclass relationship between classes. The *intersect:* operator allows one to obtain the set of objects that are members of a subclass. For example, if TenuredFaculty is a subclass of Faculty, and if setOfFaculty is a set of Faculty objects, then the operator below returns the set of tenured faculty that are in setOfFaculty:
    setOfFaculty intersect:TenuredFaculty.

To embed a set of objects from the subclass into the parent class, a simple assignment operator is used.

In order to retrieve the values of an attribute, one specifies the object and the attribute name. For instance, we may want to retrieve the value of 'degree' of an object aFaculty by the following operation:
    aFaculty degree.

This operation can also be applied to an object set in a "projection" operation. For instance, in order to retrieve the value of 'name' of each object in the set setOfFaculty, we invoke the following:
    setOfFaculty name.

In addition to actual attributes, there are certain additional "calculated" attributes that are available for object sets. For example, one may determine the number of objects of the particular object set, setOfFaculty using the operator *count* as in:
    setOfFaculty count.

This operator may be invoked for the entire object set as well.

We also need the facility to insert and delete data. In our object-oriented system, in order to insert values into an object set, the messages insertValues: and delete: (or deleteWhere:) are used to insert and delete data respectively.

The *changeAll:with:* operator updates the value of the indicated attribute and might be invoked as in the example:
    setOfFaculty changeAll:'degree' with:'PhD'.

Similar operations are available for the relationship sets.

Operations are also available to create and destroy object sets as part of a database. For creation, there is an operation *createObjectSet:withAttributes:* that creates an object set with particular attributes and adds it to the database and the message to remove an object set from a database is given by *dropObjectSet:*. There also are messages to create and destroy relationship sets. All of the operators are described in more detail in [8].

3.2 Translation of Graphical Rules

Graphical diagrams that are part of graphical rules are translated into object-oriented code that uses the library of database abstractions. As an example of this conversion, let us consider the condition diagram of the graphical rule in Figure 2A, which can be converted and appended to the condition text giving as a result the following, where "self" refers to the receiver, the object set Section:

```
setOfStudent := self selectAll.
setOfStudent := setOfStudent selectWhere:
                              #('major' '=' 'CS').
VARa := setOfStudent.
^VARa count < 5
```

The action diagram of this rule (from Figure 2C) can be converted and appended to the action text giving as a result the following, where "self" refers to the object set Student:

```
setOfStudent := self selectAll.
setOfStudent := setOfStudent selectWhere:
                              #('major' '=' 'CS').
setOfStudent changeAll:'major' with:'none'.
```

As a second example, let us consider the condition diagram of the graphical rule in Figure 3A, which can be converted and appended to the condition text giving as a result the following:

```
setOfSection := self selectAll.
setOfStudent := setOfSection relateUsing:Waitlisted.
VARa := setOfStudent.
^VARa count <= 3
```

In this code, "self" refers to each object in Section. Sections that satisfy the LHS will be passed to the RHS by the inference engine, as described in the next section.

The action diagram of this rule (from Figure 3C) can be converted, giving as a result the following:

```
setOfSection := self selectAll.
Section delete:setOfSection.
setOfSection becomeEmptySet.
```

3.3 Inference Engine

The graphical rules need to be processed in a way similar to other rule-based systems. Here we describe a simplified inference engine that shows the basic method for rules execution. More advanced inference engines can also be used, such as the one described in [5].

The operator *apply:* determines the application of the rules. This operator applies the rules in a pre-determined order until no left hand side of any rule is satisfied. The *apply:* operator also checks that each rule is not executed twice in the same environment.

Rules apply:[:aRule| aRule fire]

In the case of a class rule, the fire operator can be defined as follows:

```
objectSet := aRule className.
lhs := aRule lhs.
rhs := aRule rhs.
objectSet execute:lhs ifTrue:[objectSet execute:rhs].
```

In this definition aRule represents the rule that is being fired. The message *lhs* returns the LHS component of the rule, the message *className* returns the class name of the rule and *rhs* returns the RHS component.

In the case of an instance rule, the operator fire is defined as:

```
objectSet := aRule className.
lhs := aRule lhs.
rhs := aRule rhs.
objectSet do:[:object| object execute:lhs ifTrue:
          [object execute:rhs]].
```

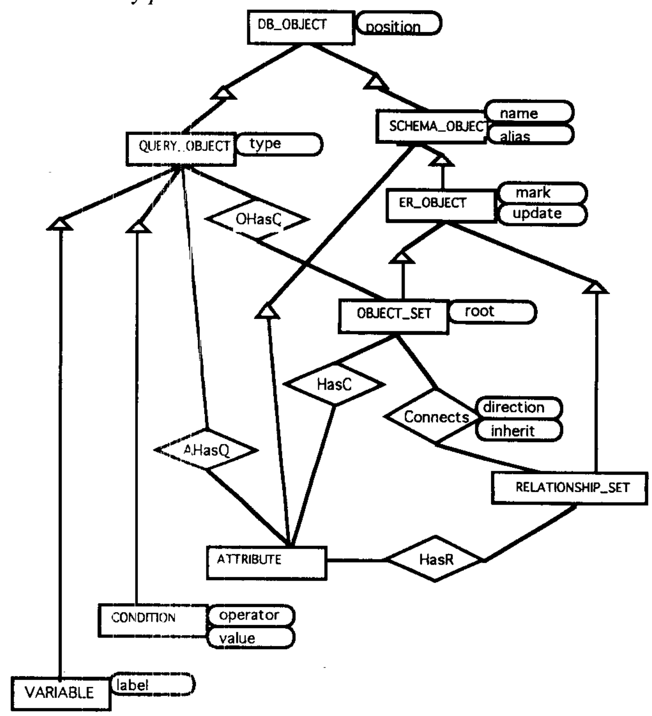
This fire operator enumerates through all objects of the base class (className) and executes the RHS for those objects where the LHS evaluates to true.

4. SYNTAX OF GRAPHICAL RULES

Let us define a syntax for graphical rules more formally. According to the discussion in the previous section, each rule is a triple (CN, LHS, RHS). The CN is the base class name. The LHS is a sequence consisting of CDs (condition diagrams) and CTs (condition text). The RHS is a sequence consisting of ADs (action diagrams) and ATs (action text). Let us first describe the syntax of a graphical condition diagram.

The condition diagrams can be formally defined by a meta-database schema. Such a database contains information about object sets, relationship sets and their attributes. The database should be enhanced to accommodate the graphical representation of conditions and variables. The database containing this information will be called MDB.

Let us describe the MDB in some detail. A simplified MDB schema is shown in Figure 4. OBJECT_SET, RELATIONSHIP_SET, ATTRIBUTE, CONDITION, VARIABLE, etc. are meta-object sets. Each object set in SCHEMA_OBJECT has its name (*name*) and alias (*alias*). The position of the each icon on the terminal screen is described by *position*.



OBJECT_SET and RELATIONSHIP_SET are subclasses of the entity set ER_OBJECT. ATTRIBUTE is a subclass of SCHEMA_OBJECT. ER_OBJECT is also a subclass of SCHEMA_OBJECT. Since all meta-objects have the meta-attribute *position*, they inherit it from the class DB_OBJECT. Likewise, both ER_OBJECT subclasses (OBJECT_SET and RELATIONSHIP_SET) inherit *update* from their parent class. The meta-attribute *update* holds an update indicator ('Insert', 'Delete' or 'None'). In a similar manner, CONDITION and VARIABLE inherit *type* from their parent class QUERY_OBJECT and *position* from the class DB_OBJECT. The meta-attribute *root* of OBJECT_SET indicates a root object set.

Each condition descriptor in CONDITION has meta attributes *operator* and *value*. Variables in VARIABLE have a *label*. There are some additional object sets, like UPDATE, that are not listed here.

HasO, HasR, OHasQ, and AHasQ are meta-relationship sets. The meta-relationship set Connects indicates that an object set is connected to a relationship set. It has meta-attributes *direction*, which indicates the direction of graph traversal, and *inherit*, which specifies an inheritance relationship. The meta-attribute inherit has values 'Sub', 'Super' and 'None'.

This meta-model together with integrity constraints describes the syntax of each graphical expression of a rule. The integrity constraints indicate, for example, that each object in RELATIONSHIP_SET should participate in a relationship with at least two objects in OBJECT_SET, etc.

Condition text is Smalltalk code that uses LODA queries as described in Section 3.

Action Diagrams can be described by the MDB, which has been enhanced to include update operations that are typical for action diagrams.

Action text is similar to condition text and is simply Smalltalk code that uses LODA queries and updates as described in Section 3.

5. SEMANTICS OF GRAPHICAL RULES

Graphical rules can be transformed into well-understood textual rules. The rules describing the transformation of graphical rule diagrams into textual rules will be called meta-rules. Therefore the semantics of graphical rules can be described in terms of such meta-rules assuming that the inference engine for the textual rules is well-understood. This is a variant of a transformational semantics approach [15].

In order to define meta-rules we extend the meta-model to include the attribute *mark* for the ER_OBJECT, which specify the nodes that have been processed as a result of the traversal of the diagram. The meta-attribute mark can contain one of three values, indicating its status in processing the rule: 'Unprocessed', 'Current' or 'Completed'. Initially the value of this attribute for each object in ER_OBJECT is ' Unprocessed '. Here we assume that the rule with lower number has a higher priority if several rules can be fired at the same time.

5.1 Meta-Rules for selections within one object set

Let us start by discussing the meta-rules for initialization. The initialization involves marking the root as 'Current' and generating the appropriate code as specified in Meta-Rule 1. For better readability we will use lower case when referring to the values of the mark attribute in the meta-rules.

Meta-Rule 1.
If an object set is a root, then mark it as 'current' and generate the following Smalltalk code:

```
setOf$1 := self selectAll.
```

where $1 is replaced by the name of the object set.

The Meta-Rule 2 and 3 are responsible for selection of appropriate objects according to the selection condition indicated on the diagram.

Meta-Rule 2.
If a 'current' object set contains an attribute condition, then generate the following Smalltalk code:

```
setOf$1 := setOf$1 selectWhere:#($2 $3 $4).
```

where $1 is replaced by the name of the object set and $2, $3, and $4 are replaced by the appropriate attribute name, operator and constant from the diagram.

Meta-Rule 3.
If a 'current' object set contains a set condition, then generate the following Smalltalk code:

```
setOf$1 := setOf$1 intersect: VAR$2.
```

where $1 is replaced by the name of the object set and $2 is replaced by the appropriate variable label from the diagram.

5.2 Meta-Rules for updates within one object set

After all objects in the 'current' object set were identified the underlying database should be updated if there are update indicators on the diagram. Meta-Rule 4 is responsible for modification of attributes and Meta-Rule 5 is responsible for deletion of the appropriate objects.

Meta-Rule 4.
If there is an update box for the 'current' object set specified in the diagram, then we append the following to the Smalltalk code:

```
setOf$1 changeAll:'$2' with:'$3'.
```

where $1 is replaced by the name of the object set and $2 is replaced by the appropriate attribute name and $3 is replaced by the appropriate constant from the diagram.

Meta-Rule 5.
If there is a delete indicator for the 'current' object set specified in the diagram, then we append the following to the Smalltalk code:

```
$1 delete: setOf$1.
setOf$1 becomeEmptySet.
```

where $1 is replaced by the name of the object set from the diagram.

Note that typically the objects identified for the deletion will belong to the object sets identified as leaves on the diagram.

5.3 Meta-Rules for variables

After all modifications are done, either the objects or their attributes can be stored in a temporary variables for further processing.

Meta-Rule 6.
If there is an attribute variable on a 'current' object set specified in the diagram, then we append the following to the Smalltalk code:
VAR$3 := setOf$1 $2.

where $2 is the name of the attribute, whose value is assigned to the variable, setOf$1 is a set of objects (from the corresponding object set after selection) and $3 is the variable's label.

Meta-Rule 7.
If there is a set variable on a 'current' object set specified in the diagram, then we append the following to the Smalltalk code:
VAR$2 := setOf$1.

where $1 is the object set (name) and $2 is the variable label.

5.4 Meta-Rules for graph traversal

Once all necessary operations are performed on the 'current' object sets there might be the need to continue the traversal of the graph according to directed edges if the diagram indicates so.

Meta-Rule 8.
If a 'current' object set is related to an 'unprocessed' object set (proper direction of the directed edge set and there is only one directed edge pointing to the 'unprocessed' object set), then set mark to 'completed' for the 'current' object set, and mark the 'unprocessed' object set as 'current', and generate the following Smalltalk code:
setOf$2 := setOf$1 relateUsing:$3

where $1 is replaced by the name of the object set name, $2 are replaced by the the related object set name and $3 is replaced by the relationship set name.

Meta-Rule 9.
If a 'current' object set has an 'unprocessed' subclass object set (proper direction of the directed edge and there is only one directed edge pointing to the 'unprocessed' object set), then set mark to 'completed' for the 'current' object set, and mark the 'unprocessed' object set as 'current', and generate the following Smalltalk code:
setOf$2 := setOf$1 intersect:$2.

where $1 is replaced by the name of the object set and $2 are replaced by the subclass object set name.

The similar meta-rule (Meta-Rule 10) can be specified for 'unprocessed' superclass object set that would generate the following Smalltalk code:
setOf$2 := setOf$1.

where $1 is replaced by the name of the object set and $2 are replaced by the superclass object set name.

5.5 Other Meta-Rules

There are additional meta-rules that are not described here. One of those meta-rules enables us to traverse the graph similarly as Meta-Rule 8, but assumes that there is a graphically specified condition for the involved relationship set (Meta-Rule 11). There are also meta-rules that allow additional database operations, such as updates for relationship sets. If the diagram includes more than one relationship set directed to one object set then either the meta-rules 8 - 11 need to be modified or additional meta-rules should be specified. See [9] for additional explanations of the system operations.

6. REPRESENTATION OF META-RULES

The meta-rules described in the previous section, were stated informally. They can be also described using the graphical representation discussed in Section 2.

Meta-Rule 1 is a class rule and the LHS of this rule can be represented by the condition components shown in figures 5A-B.

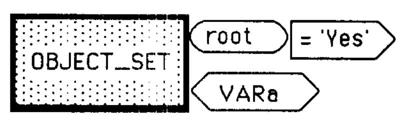


Figure 5A. Condition diagram for **Meta-Rule 1**.

^VARa count = 1

Figure 5B. Condition text for **Meta-Rule 1**.

The action diagram for the RHS of this rule can be represented in figure 5C:

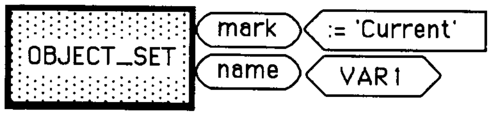


Figure 5C. Action Diagram for **Meta-Rule 1**

The action text for the RHS of this rule can be represented as in Figure 5D.

newCode := 'setOf$1 := self selectAll.' substituteBy:
(Array with:VAR1).

Figure 5D. Action Text for **Meta-Rule 1.**

The operator *substituteBy:* replaces each occurrence of $1 with the item (object name, in this case) found in VAR1. The newCode that is formed in this manner can then be appended to some other code.

7. SUMMARY AND FUTURE WORK

In this paper a graphical representation of rules is proposed. The graphical rules are formulated based on Extended Entity-Relationship (EER) diagrams. Such diagrams are compiled into an object-oriented language code that is included as a component of the developed software system.

We identified two types of graphical rules: class graphical rules and instance graphical rules. The syntax and semantics of both types of graphical rules were discussed. We allow both graphical diagrams and object-oriented code in each part of the graphical rule. This way, we significantly alleviate the mismatch between the rule-based programming paradigm and the object-oriented paradigm.

In this paper we assumed that our graphical rules are based on directed acyclic graphs. However, generally, deletion from or insertion into relationships requires two directed graphs (with an un-directional relationship set between them). We will include those extensions in our implementation. Another direction of future work is to include high-level object sets and relationship sets in order to improve modularity of graphical rules.

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The development and usage of a Stock Exchange Real Time Client/Server Environment : utilizing advanced Information Technology in Economics and IS Curricula

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Abstract

This paper discusses about benefits the Faculty of Economic Sciences, Business Administration and Econometrics of the Free University in Amsterdam experiences from the development of an advanced stock exchange client/server environment. Originally, the idea goes back to 1981 when students, researchers and a systems administrator implemented a portfolio simulation system for usage within a financial investment course. The unique feature of the portfolio simulation system known as TRANSPAS, an acronym for TRANSaction Portfolio Simulation, was its real-time data link with the Amsterdam Stock Exchange (ASE) through which trading data were received and used to simulate portfolio management.
At the same moment TRANSPAS went out of operation (December 1992) ASE announced fundamental changes in trading. In advance of the adoption of the necessary new trading systems (September 1994), ASE decided that its external real-time data links needed modification because their new computer systems would entail a significant increase in trade (April 1993). The faculty formed early 1993 a project team to examine TRANSPAS. In rebuilding TRANSPAS 'state-of-the-art' concepts were included, for example, relational database technology would be used for storage of ASE data. The database would be referred to as BeursBase. TRANSPAS was renamed to VUPOS, an acronym for Vrije Universiteit POrtfolio Simulation.

During the development and implementation stages (1993-1994) the project team argued that there would be sufficient demand for historical data to motivate storage of ASE data for a longer period of time. This idea was supported by the results of a survey held (May 1994) among faculty members, graduate students and assistants, which showed that at least 25 percent of the respondents was highly interested in BeursBase, its data and its applications. Because many respondents came up with ideas on application areas and specific applications, the project team developed a general application framework. This application framework shows a faculty wide support of BeursBase for research, educational and public relation purposes. Based on the survey result the project team decided to make BeursBase available to application development other than VUPOS.
This paper addresses the tremendous impact the development and use of BeursBase and its applications have on research, education and public relation activities of the faculty. In co-operation with the business environment various interesting research issues have turned into on-going projects, some of which are briefly discussed in this paper. Application of advanced information technology concepts in IS and economics curricula has provided the faculty even better co-operation and communication within departments, between departments and with the business environment. In this paper the 'added-value' of the stock exchange client/server environment is discussed in terms of benefits for research and education at the faculty and for the business environment. It can be argued that society benefits from IT and IS developments applied at the faculty.

1 General background

In the early 80s a small group of lecturers, researchers and students at the Faculty of Economics, Business Administration and Economics of the Free University in Amsterdam developed the idea for a portfolio simulation system. From both a finance and an information systems perspective one propagated to provide students of economics with some scientific 'real market' skills and experience in portfolio management. The Amsterdam Stock Exchange (ASE) would sponsor the faculty by establishing a toll-free data link, between ASE and the faculty, with its administrative clearing information system. This data link provided the faculty with real-time exchange data like time, price and volumes of traded securities. Though at that time the technology applied was relatively simple, the portfolio simulation system developed exclusively for educational purposes performed very well. Officially the system was known as TRANSPAS, an acronym for TRANSaction Portfolio Analysis and Simulation. Over the years the system was hosted by various hardware. The faculty started with a DEC PDP-11 (1981) and moved from a DEC VAX 750/11 (1985) to a IBM RT 6150 (1988). Unfortunately this system went out of operation at the end of 1992. There was no change that the many lines of TRANSPAS C-code could be ported to another UNIX-based without much effort and costs.

In the early 90s ASE decided to redesign their information systems because foreign Exchanges especially London, Paris, and Frankfurt attracted more and more trade. Adopting a new trade system implied that the ASE data link system had to be redesigned as well. In contrast with the ancient data link, using 1.2Kbps asynchronous communication (Simplex protocol), the new data link was first (April 1993 to October 1994) based on 9.6Kbps asynchronous communication and moved (October 1994) to 19.2Kbps digital synchronous communication, using X.25 packet switching protocol. The new trade information systems went September 1994 in operation.

Recent developments in the 'Information Age', such as emerging electronic (super)highways, multi-media, desktop computing and many more combined with the need for 'real market' skills and experience ask today even more for a powerful portfolio simulation system than a decade earlier. Based on these developments a group of lecturers, researchers, students in co-operation with the faculty took the initiative to redesign TRANSPAS (December 1992). In contrast with TRANSPAS original development a structured approach was introduced and by thorough examination possible opportunities of real-time stock data should be analyzed. The following faculty goals were defined:

- ☞ Development of a unique stock data database containing both real-time and historical data;
- ☞ Development of user-application programs;
- ☞ As wide as possible usage of stock data within the faculty (research, education, public relations);
- ☞ Application of state-of-the-art technology;
- ☞ Closer co-operation with ASE, finance and IT firms and SARA, the university central computer center.

Adoption of above goals concurrently would raise several problems, therefore a priority schedule was introduced. First the X.25 data link was of vital importance for the project. Secondly, establishing a relational database was crucial for all application development. Thirdly, the primal application still would be a portfolio simulation system. Fourthly, development of other applications and exploration of the stock database would be supported in a later stage. So three subprojects were defined. The first project defined was the development of a X.25 ASE data link. The second project defined was the development of a data model for BeursBase, the stock database. And the third project as the development of Vrije Universiteit Portfolio Simulation system, or VUPOS, a new portfolio simulation system.

In the next paragraph the impact of the overall project on faculty activities is discussed. The faculty goals defined are integrated into an application framework. Based on this framework the roles of information technology, business, econometrics and the faculty are discussed. The third paragraph discusses a number of on-going research projects which exploit BeursBase and its data. The fourth paragraph elaborates on the planned developments. The fifth and final paragraph is used to communicate some experiences and recommendations and draws final conclusions on the issues discussed in this paper.

2 The application framework

2.1 Introduction

A thorough examination of the possible opportunities of BeursBase containing both real-time and historical data would benefit from empirical research. Therefore a survey was held among faculty members. Over a hundred colleagues, lecturers, researchers (including graduates) were asked for their opinion on relevant usage of exchange and stock data in their activities. Based on the survey response (about 25 percent) the project team developed an application framework (figure 1).

The user application area perspective defined consists of *research*, *education* and *public relations*. In addition three other perspectives are identified, a discipline perspective, an information technology perspective and an organizational perspective. Although this last perspective cannot be directly identified in figure 1, as several organizations and departments are involved, one cannot ignore the organizational perspective. The perspectives named are discussed next, in terms of their role they have in the application framework and their importance on the further development of BeursBase.

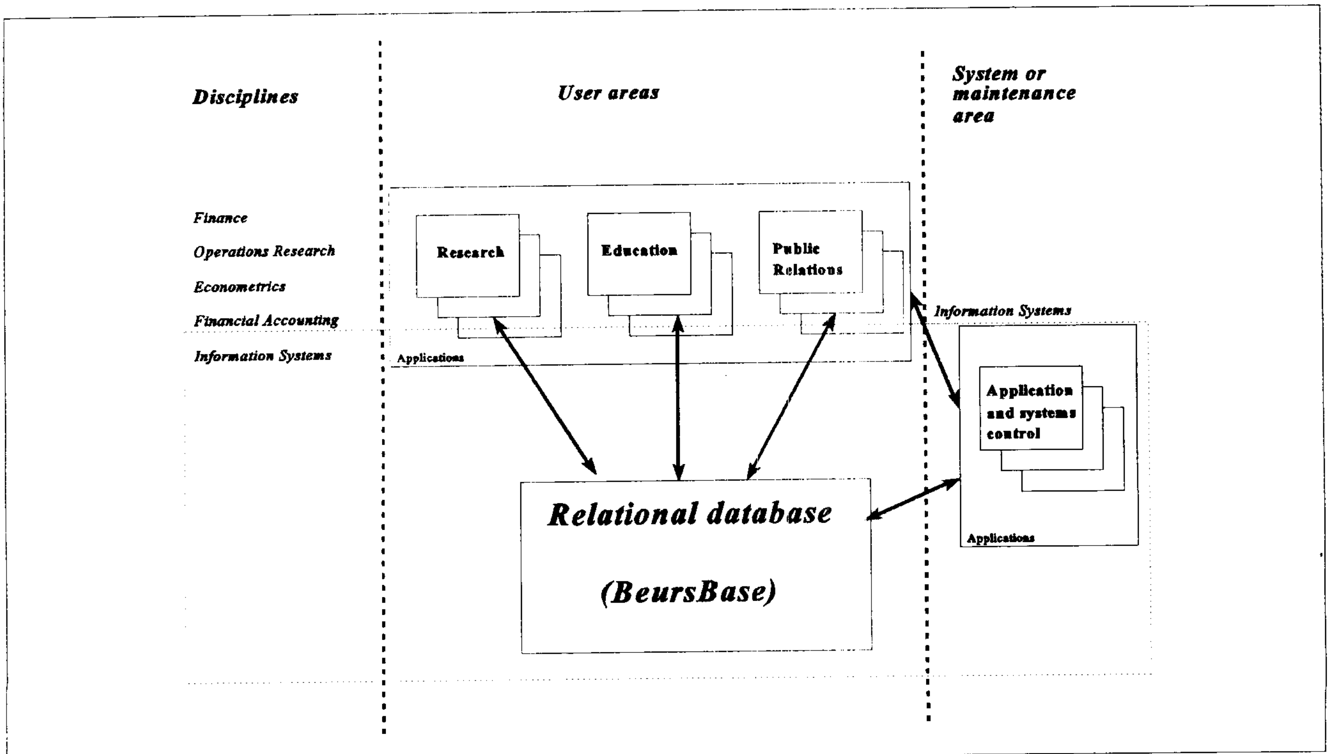

Figure 1 The application areas for both real-time and historical stock data in a scientific environment.

2.2 The role of the faculty (the user application area perspective)

At universities research and education go hand in hand. Concepts, theories, research methods combined with analytical thinking are lectured to both graduate and undergraduate student populations, of various disciplines. The faculty provides education in many different forms, for example semester or trimester courses, practical classes, workshops and graduation projects. Each of these forms of education require specific examination. A course ends with an exam, practical classes, workshops and graduation projects end with delivery of a research paper or a document, which size correlates with the amount of time spent on the specific project.
Up to this moment the public relations user application area is not very known. In contrast with some courses in which for example marketing concepts (to be) applied in business are dealt with in detail, the university nor the faculty does not 'think' commercial (yet). However, in times of severe competition among the six faculties of economics which nowadays is the case in The Netherlands, the priority of public relations activities increases. Fact is that student populations are declining, especially economics sciences, computer sciences and law have faced significant drops in freshmen over the last few years. Knowing that the nations population is aging for the next twenty or more years, it is vital to attract as much new students as possible, to minimize the reduction of the faculty staff. With structural budget cuts announced by the Administration is it the question if this inevitable anyway. However, public relations activities are necessary to attract as many students as possible. Therefore BeursBase and its application programs like VUPOS are invaluable and can be used as 'strategic weapons' in these activities.

2.3 The role of economics (the disciplines perspective)

The ultimate goal is to enable as many disciplines as possible (at first within the faculty) to use BeursBase for research, education and public relations purposes. Of the available disciplines within the field of economics, at least Finance, Econometrics, Financial Accounting, Information Systems and Operations Research/Management Science can benefit from BeursBase as described earlier.
In each of these disciplines stock data and/or BeursBase itself can be incorporated in research, education and public relations activities. For many of these disciplines new research concepts, phenomena, ideas, or comparative research can be initiated and developed. Some of these research efforts result in one or more application programs which can be developed by researchers and used by students or be co-

developed by students as well. In turn, using some of these application programs, like VUPOS (the portfolio simulation system) generate voluminous data on portfolio decisions which itself can be subject of subsequent research.
In summary, BeursBase can be subject of research, education and public relations activities within a faculty of economics. A variety of research topics can be defined by researchers and students. Students are provided with many issues, ranging from conceptual to fundamental and from non-technical to technical, from many different disciplines and curricula within the faculty of economics.

2.4 The role of information technology

The goal of the faculty computer support staff is limited to provide basic hardware, software and networking support. Hardware support is limited to the computers in public rooms and the computers of faculty members and userids for the SARA host systems. Software support is limited to basic MS-DOS, MS-Windows and OS/2 software packages. Host software of SARA is not supported but are exclusively the concern of the user. Limited networking support is provided for Banyan Vines (LAN) and Internet (Gopher and World Wide Web). Since April 1995 have all students of the faculty (approximately 3100) a personal study-mail address (email) which hands them Banyan and Internet access. In short, the faculty provides basic means for researchers and students though does not support specific application development activities.

VUPOS and BeursBase went in operation in the autumn of 1994. During the 1993-1994 test phase the project team was responsible for VUPOS and BeursBase. However, system control and maintenance of operational systems are no core activities for project team members, thus the faculty should be held responsible for VUPOS and BeursBase. Compared with the other, basic activities, this activity adds value to the work of the faculty computer support staff members.
From an IS perspective the unique issue is that once a scientific environment has been tested and approved, responsibility shifts from researchers to the faculty. Another exception with respect to IS is that these IT developments are the concern for all disciplines within the faculty. Put in other words, a way of integrating economic sciences and disciplines is by using and applying advanced IT concepts and systems. Identifying and utilizing new leading-edge technologies make the IS curriculum within the faculty from both research and educational perspectives very attractive.

2.5 The role of organizations involved

The framework is founded on the co-operation of several organizations. First, the link between ASE and the faculty is unique within The Netherlands, and probably outside The Netherlands too. Secondly, the university provides the means for the central academic computer center, SARA, which in turn provides various services. These services enable the faculty to locate VUPOS and BeursBase on several SARA host facilities. Thirdly, the faculty has a close co-operation program with the Amsterdam Academy (AA), which offers a three year finance-based BA programs. AA-students have the opportunity to change part of their BA education (the last three years) for a MA level education (three years) named BFS. AA and BFS student are especially useful in the research and education user application areas within the finance and econometrics disciplines. Last but not least are involved financial organizations (banks, brokers, financial service providers, data vendors), IT corporations (hard- and software firms, IT-service providers, Internet providers) and education institutions (universities, high schools). These firms become more and more familiar with the VUPOS and BeursBase developments at the faculty, and show high interest in these developments.

2.6 The application area framework: integrating the different roles

Since BeursBase went in operation in 1994 faculty members and students have the opportunity to build and use all kinds of application programs for research, educational and/or public relation purposes. For example VUPOS, built by researchers and students, can be used to collect portfolio decisions (information) over time. The information about these decisions may, in turn, be subject to further research and analysis. It would be interesting to analyze portfolio decisions from professionals, students of economics, high school students and laymen and search for significantly different results in terms of performances and decisions. This kind of information is collected automatically using VUPOS in practical classes for finance, or investment competitions among high school students. Therefore we infer that VUPOS can be used for research, educational and public relations activities.

Research outcomes are not only of great interest to the IS and Finance communities but to the business environment as well (see table 1).
For Econometrics and Management Science stock data is fruitful for testing and calibrating econometric (statistical, linear and numerical programming) models and for sophisticated statistical analysis. From a research perspective statistical procedures and concepts can be investigated. Or, market efficiencies, financial and market performance indicators can be developed with appropriate stock data subsets (level of detail), and subsequently be tested on their validity and consistency. On a smaller scale these issues are to be researched by students. Ideally students design, develop and implement small prototypes for data analyses using general software (Lotus, SPSS) or specific languages (C++, APL).

Application area / Discipline	Research	Education	Public Relations
Finance	Portfolio management and theory; Theory on market efficiency; International stock markets, Development of performance indicators Analysis of stock market and financial investment data Design and application of IS and DSS	Portfolio management simulation; Data analysis; Application of IS and DSS; Practical classes; Workshops; Seminars;	Financial investment competitions; Demonstrations; Financial workshops; Financial seminars; Bank and stock market sponsoring; Media (financial and newspapers);
Information Systems	Design and application of DSS, ES, KNN systems Database concepts and theory System and application development concepts (Client/Server, Object Orientation) Application of IS and DSS Human computer interface	Data analysis; Application of IS and DSS; Practical classes; Workshops; Seminars;	Financial investment competitions; IS demonstrations; IS workshops; IS seminars; Media (IS and newspapers);
Econometrics	Statistical (exploratory) data analyses Longitudinal and time series analysis Design and application of IS and DSS Design of simulation models	Data analysis; Application of IS and DSS; Practical classes; Workshops; Seminars;	Financial investment competitions; Demonstrations; Workshops; Seminars; Media;
Financial Accounting	Analysis of performance indicators Analysis of stock and equity issues Design and application of IS and DSS	Data analysis; Application of IS and DSS; Practical classes; Workshops; Seminars;	Financial investment competitions; FA demonstrations; FA workshops; FA seminars; Media;

Table 1 Framework for application program development.

From a business perspective analyses of standard financial software packages, fed with stock data from BeursBase, may gain insights in concept and software quality and usefulness. If at the one hand problems, shortcomings to the software or underlying concepts, and at the other hand new concepts, ideas and models are the result of this research, one can communicate these results with the software developer (financial or IT firms). This brings both academic and business environment a step closer.
Also, from an information and decision support system perspective software development itself can be research with respect to new technologies like Object Orientation, Computer Aided System Engineering (CASE) , and Artificial Intelligence (expert systems, artificial neural networks). Information Systems, with respect to the other disciplines shown in figure 1, forms an exception as it is the exclusive discipline incorporating development of BeursBase itself in research and education. In figure 1 this is shown by a dotted box which includes both applications and BeursBase. The other disciplines do use BeursBase for its data, not for development of BeursBase, in terms of database concepts and theories to be tested and validated.

Finally, theories and concepts in the area of parallel processing, operating systems databases, languages, communication networks, and integrity issues are less subject of information systems and more of computer science. Issues of system and network performance, large scale database processing, client/server have great interest in this field of research. Especially when a large laboratory as VUPOS and BeursBase is at hand. One can infer that research results from Information Systems will result in more advanced applications in information systems and the other relevant economic disciplines.

3 Ongoing developments

3.1 Introduction

Each of the disciplines named in the previous section benefit tremendously from BeursBase and its application programs. Lecturers and researcher use BeursBase, its application programs and its developments to clarify scientific theories, concepts and ideas. Using BeursBase recent developments are lectured and discussed with a 'high-reality' value. For example in the information systems course system development methodologies, concepts like object orientation and client/server are explained with actual working and demonstrable examples. In the discussions with colleagues, researchers, and students, relevant critics and directions are used to refine the ASE database concepts and its application programs. Also in the decision support systems course examples of expert systems and artificial neural networks are discussed in concept and to some extent are demonstrated by working prototypes.
The utilization of BeursBase material, its data and its application programs, answers many answers yet raises many questions too. Some of these questions may turn again into research topics. In this section we focus on the most important issues to be researched in this year.

3.2 X.25 Data link reliability

From both a research and educational perspective, especially for the department of information systems, is it highly interesting to examine the faculty-ASE X.25 data link. The

question is: how can one guarantee that the X.25 data link is fully reliable? It is clear that the faculty-ASE X.25 data link is the most volatile part of BeursBase. When BeursBase is used for research purposes one has to rely fully on its integrity and completeness. Put in other words, BeursBase should contain all data which should be consistent and valid. If this is not the case, bias is introduced in the research results, which may entail dramatic consequences.
In the spring of 1995 a project has been started to examine the quality of the faculty-ASE X.25 data link. Up to now a single data link is implemented. Important is that ASE guarantees the delivery of data only the day itself and does not keep data longer than needed. There are many of possible events which threat the X.25 data link. The most likely are: a power failure, a telecommunications error or a hardware failure. If the X.25 data link cannot be restored instantaneously, the real-time link is lost. If the X.25 data link cannot be restored the same day, data will be lost, leaving a corrupted inconsistent BeursBase.
The department of Information Systems found out that to guarantee the X.25 data link an significant investment would be necessary. The following additions have to be made:

→ an atomic clock connection (for an exact time);
→ an Uninterruptable Power Supply (UPS) system;
→ two remote boot systems;
→ a second, fully separated, X.25 data link including computer;
→ a checking mechanism for the two X.25 data link computers;
→ a hour service contract for both machines;
→ a software monitoring control mechanism.

These enhancements guarantee a fully reliable X.25 data link. The likelihood that both machines and the faculty LAN server are down is very small. The same can be said about the X.25 data links, which are totally separate (from ASE to faculty). The result is a fully autonomous X.25 data link environment. It is believed that mid 1995 these investment will be made. It is a challenge for researchers and students to establish such a high quality environment and to study its operation.

3.3 Second generation of VUPOS and BeursBase

Originally VUPOS and BeursBase development started mid 1993 hosted on an IBM mainframe of SARA the central university computing center. Although being the most advanced computer system available, it did not support development of client/server applications. Therefore both BeursBase and its application programs (VUPOS) would reside on the host. However, in 1994 SARA announced that its IBM mainframe service would be stopped at the end of 1995. In 1993 SARA had already adopted an IBM AIX cluster, though this newer technology was not selected as BeursBase host because there was no database management system available. When DB2/6000 became mid 1994 available for the AIX cluster and the fact that SARA would support this environment also after 1995 the project team selected AIX cluster as the successor of IBM mainframe.
As DB2/6000 supports full client/server development the project team decided mid 1994 to develop concurrently a BeursBase database server and as its first application program a ***second generation*** of VUPOS. The client/server version of VUPOS will be equipped with many state-of-the-art features (object-orientation, graphical user interface, menus, buttons, graphs, an so on). Because the complexity of the second generation of VUPOS and the extended functionality, it will not be finished before June 1995. In the spring and summer of 1995 this VUPOS will extensively be tested by a substantial audience (colleagues, students, graduates, financial experts) in several financial investment competitions. Early 1995 new plans have been developed to extend this second version of VUPOS and BeursBase with data from the European Option Exchange (EOE), which resides in Amsterdam. This development will be discussed in paragraph 4.

3.4 User application and tool development

Having the knowledge that SARA would stop its IBM mainframe service at the end of 1995, the project team decided from the 1994 autumn and on to develop user application programs and tools exclusively for the client/server BeursBase. For every area defined in the application framework (research, education, public relations and system or maintenance) applications have to be developed. In most cases these application programs are the result from research or education issues and developed by researchers, and both graduate and undergraduate students.
The following on-going projects give an overview of the application programs to be ended:

Research/Education areas (Finance/Econometrics/Information Systems):
→ A Decision support system for analysis of the correlation between stock and quote/futures data;
→ Application program for performance indicator development;
→ An application program for exploratory data analysis.

Research/Education/Public relations areas (Finance/Information Systems):
→ A World Wide Web interface for VUPOS (Information Systems, see section 3.6);
→ A World Wide Web server for ASE with real-time index feeds (Information Systems, see section 3.6);

System or maintenance control area (Information Systems, Computer Science):
→ A BeursBase DBA tool for performance optimization and monitoring;
→ An application shell for integration of all user application programs and tools;
→ BeursBase datamodel extension and development.

Projects are defined by lecturers and researchers and are partly implemented by students. Besides the resulting application program much emphasis is on the theoretical scientific concepts initiated by lecturers and/or researchers and further developed by students. The resulting solutions, papers, and systems are examined by the lecturers and/or researchers on quality of the solution in terms of scientific added value, consistency and validity of the solution and the robustness of the working prototype. Not every system design and solution to a problem turns into a working prototype, nor is it a compulsory prerequisite. However, in most cases researchers and students working in teams are so enthusiastic that a prototype was perceived as a logical consequence.

In most of these projects two to three students, preferably from different disciplines, work jointly in a team. Each of the team members has his/her own responsibility and together they are responsible for the total solution presented to the lecturer/researcher. If possible teams are established with students from different disciplines in order to enhance and improve students knowledge of the involved disciplines and to establish interdisciplinary communications. A fine example is the co-operation of IS students with BFS students in more technical, system or maintenance control area applications, for example application program and user authorization management. Another good example is the joint development of VUPOS (both versions) by financial and IS students.

3.5 Financial investment competitions

VUPOS like TRANSPAS was originally developed to educate economic students portfolio management in practical classes. This still is the primary VUPOS goal. In second place VUPOS generates an enormous volume of data on portfolio decisions which can be subject to research itself. This is also the case of the concept of using simulations within an educational setting. But aside from research and education, the project team found that VUPOS could be used as a public relations 'weapon' as well. From the end of January to march 1995 as a test and a graduation project for two IS students, a financial investment competition was set up for high school students. Each high school in the competition was 'given' 500.000 virtual dollars with the mission to generate as much money as possible within nine weeks. The unique feature of this competition was that it would be integrated in the economics classes at the high schools. Every class one or two high school students had to formulate and explain their strategy to the rest of the class. A class had 5-10 minutes available to reach general agreement on its investment strategy. Accordingly, relevant buying and selling orders had to be put on a decision form and faxed to the competition command (students). After putting the orders into VUPOS, the students frequently 'look' if transactions have occurred. If this is the case the resulting portfolio is faxed to the high school.

Within the nine weeks period three newsletters were designed and mailed. Topics included interviews with good performing high school classes, and general information of ASE and the economy in general. Besides this newsletter, ASE provided all high schools during the competition a free subscription to 'Beursplein', ASEs weekly 'Wallstreet Journal'.

The first aim of this research was to find out if VUPOS was suited to be used outside the faculty and what functionality VUPOS lacked for this purpose. The second goal using VUPOS was to find out what the impact was for the faculty using VUPOS as a public relations 'weapon'. The third goal was to look at VUPOS as a means to gather large volumes of financial investment data. The fourth goal was to examine new alike opportunities for VUPOS.

The outcome of this research and graduation project was very positive. In short, the VUPOS concept is very suited to support financial competitions. Actually no functionality was really missed, though graphic support was highly desired. For future competitions this problem will be solved when the client/server version of VUPOS becomes available, which comes with a graphical user-interface. From a public relations perspective the competition which was a tremendous success led to many newspaper articles. A survey among the competing high schools revealed that, without an exception, every high school would subscribe to next years competition.

In the future the faculty things of planning and organizing one or more of the following competitions:

- → A competition among all members of the faculty (lecturers, researchers, graduate and undergraduate students);
- → A university wide competition;
- → A competition among economics students of all faculties in the Netherlands;
- → A full Internet-based competition;
- → Global competitions.

In every case the project team was faced with manageability of these competitions, as client programs need access to the database server hosting BeursBase. In addition, most client/server application are developed in OS/2, though neat, not the most common used operating system. The solution to this problem was simple, and yet defined another research and education application of BeursBase. The development of a World Wide Web interface for the client/server VUPOS, which will be discussed in the next section.

3.6 Introducing World Wide Web to ASE

Early 1995 the department demonstrated the power of World Wide Web to ASE members. The faculty has gained experience since mid 1994 with WWW. Because Internet access and usage for both the private and the professional environment is growing rapidly in The Netherlands, and the fact that VUPOS and BeursBase are unique in its kind in The Netherlands this should be exploited for the benefit of both organizations. From a commercial perspective ASE could benefit from this development and become a WWW information provider for its products, its data and services and, for example, as a gateway to all kinds of securities and financial investment associations. From a faculty point of view WWW is interesting to use as a medium to play Internet-based simulations and to offer means for real-time information. The logical step in introducing simulations to WWW is to develop an WWW interface to VUPOS which makes VUPOS accessible for the Internet public. The co-operation with ASE is recently intensified by starting up a project such a WWW facility for ASE. Two students are selected for a fully sponsored ASE WWW graduation project. Their mission is to develop the WWW facilities, including the information products and services to be offered, and a feasibility study for future commercial exploitation. A final subgoal is to develop a prototype for delivering on a real-time basis the stock exchange index (Amsterdam EOE Exchange, or AEX) in graphical form to WWW. An important aspect in this research project is to monitor actual usage and user opinions. This is project is fully financed by ASE, such as hardware, software and student allowance. The first empirical results are to be expected mid 1995. The URL of the ASE WWW site is: http://wwwaeb.econ.vu.nl .

4 Planned developments

BeursBase has many opportunities of which a small number are on-going projects. The following project have only been planned and are not active. Co-ordination problems may occur when too many projects run in parallel. Furthermore, some projects unavoidable have to be executed sequentially as they need results from former projects. The following projects are started in 1995:

Extending BeursBase with European Option Exchange data
The project team assigned a high priority to the extension of BeursBase with an European Option Exchange (EOE) data feed. Like ASE the EOE, one of the few Option Exchanges in the world, too is located in Amsterdam and provides option and futures trade data to financial institutions (including ASE), media, though very limited to universities and research organizations. Except for some financial media, there is no organization which has a real-time EOE data link. BeursBase gains significant importance from both a research and education perspective if EOE data is added. The project team is in a negotiation phase with the EOE. From the side of the EOE one is highly interested in BeursBase developments, including Internet and WWW;

Market prediction using artificial intelligence
A very interesting research area is the application of artificial intelligence on financial markets and services. It is the amount and detail of data available what makes this research area so special. For the first time, at least in The Netherlands, one has the opportunity to extract knowledge, patterns, from very detailed data for example with artificial neural network technology. This knowledge can be used to measure the quality of financial market prediction and forecasting systems. Another interesting track is the development of portfolio simulation models (for VUPOS) which incorporate concepts like price elasticity. In contrast with these data intensive applications, one can study the quality of expert systems for prediction and forecasting which rely more on heuristics. Though even more interesting is to compare the performance of different technolgies applied.

Exploratory data analysis
There are many ways to explore large data sets, such as using artificial intelligence, statistics and econometrics. Question is: which technology and which concept prove to be most appropriate. Exploratory data analysis comes in many forms and has many perspectives. Techniques such as extrapolation, time series analysis, longitudinal analysis, seasonal influences, are worth testing

Comparative research: foreign research
From a research perspective comparative studies of stock exchanges, financial markets and multinational firms have high priority. However due to lack of data some of these interesting projects could not be started because there was no data available with appropriate detail. As BeursBase grows in size in time having the maximum detail as possible, it is now the moment for planning such projects.

Dealing room simulation
From both research and educational perspective it is a challenge to develop dealing room simulations by, for example, integrating in VUPOS both Amsterdam Exchanges. Including options and futures in portfolio management increases the added-value of VUPOS significantly. Aside from VUPOS one can think of a dealing room simulation, in which teams of students manage portfolios or substantial assets. These applications, include finance concepts like hedging, give significant value to research and education.

The developments described in this section are not developed exclusively by the project team, rather come from many lecturers, researchers and graduate students from different economic disciplines. This is to say that there is a commitment from the faculty and its members that BeursBase is exploited and extended for research and educational purposes.

5 Conclusions

This paper ends by presenting the most important findings and conclusions from our efforts in developing and using a stock exchange real time client/sever environment in economics and IS curricula. The findings are presented randomly:

- The computer support staff aids in more complex and more interesting activities like system development and communication control. These activities enhance the quality of work;
- The costs of BeursBase and application program development are relatively low by support of sponsors. In addition, no expensive programmers are involved. Researchers and student do most of the practical and operational work;

- Benefits for science: application of prototypes and examination of data make studies more empirical and more attractive;
- Benefits for education: students work with and experience 'real systems' and get capabilities in system design and development. Students benefit from experiences in teams;
- Benefits for public relations: the faculty gets publicity from the public community (media) and the scientific community as well (research and education papers);
- From an Information Systems and Computer Science perspective is it necessary tot work with advanced environments like computer systems, computer software and communication infrastructures;
- Business (banks, IT firms, brokers, ASE), universities, and other organizations (SARA) are very interested in BeursBase developments;

Finally some recommendations the project team comes up with so far:

- Commitment of the faculty is a must;
- Commitment of members of the faculty is even more important;
- The faculty should install a committee whose responsibility is to maintain the continuity of the environment, to take care of the financial issues (control the budget) and to arrange sponsoring. A long-term program should be developed which specifies research, educational and public relations purposes;
- Project planning and frequently project meetings are of vital importance;
- Though we get many enthusiastic response from scientists, researchers, students and the faculty, as much people as possible have to be involved in the development of the environment;
- A perfect long-term relationship with sponsors like ASE is indispensable.

The project team believes that within two years, dozens of projects have been defined, papers have been written and published, and application programs become operational for the faculty and maybe even the whole scientific community. And dozens of economics students graduate with both theoretical and practical skills advanced Economics and IS having used BeursBase and/or extended it application area.

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Martin P. Misseyer (1964) who works as an assistant professor at the department of Information Systems is the main architect and DBA of the BeursBase environment. He also works on a dissertation about environmental decision support systems which he has planned to finish in 1996. His areas of interest are databases, system development, decision and expert support systems, and last but not least electronic highways.

PREPARING ALL STUDENTS FOR THE GLOBAL MARKETPLACE: HOW DO WE DO THE JOB, AND HOW DO WE KNOW WE'VE DONE IT?

Panel Session

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The "literacy" course in computing is constantly changing even though the underlying concepts remain steady. To meet the expectations of students and faculty from other disciplines, we must use the most up to date application software available. Our students want to learn these tools but generally do not realize that their future success depends on their abilities to adapt to the new tools that will be available throughout their careers.

Each of the panelists comes from a different academic, teaching and industry background. All teach this course at Pace University; we have common objectives but different approaches. The topics we will discuss include:

- Evolution of course
- Process: generating enthusiasm (group projects and interactive lecturing)
- Financial constraints
- Product: transferrable knowledge, organizational and problem solving skills
- Assessment: individual vs. group; actual knowledge vs. growth
- Time and competing pressures on students
- Content: specific applications; less vs. more
- Course Coordination and team teaching (typically 13 lead faculty, 13 adjuncts, 3 campuses, 1200 students per year).

We will discuss our past, present and future approaches.

Integrating Technology Into the Business Curriculum

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ABSTRACT

The increasingly rapid change in business practice today are due largely to the application of computer technology to business problems. However, although technological change is measured in months, curricular change is measured in years. How can the business curriculum respond to the changing needs of the business community? This paper describes a dynamic feed-back process which involves all stakeholders: employers, faculty, students. The objective of the process is to ensure that current business computer application concepts and tools are being integrated into the business curriculum Computers are seen as assets which enhance the strategic positioning of an enterprise, release employees from repetitive tasks, and hasten accurate responses to required problem solving and analyses. The process consists of an annual census of computer competency of the entering business students, involves the Board of Advisors of the College, and empowers the faculty to modify the manner in which technology is integrated into the curriculum.

BACKGROUND

A strategic plan for the University developed in 1993 called for assessment of learning objectives in those programs determined to be essential for the educated person of the 21st century. One of these programs is the integration of computer applications into the core curriculum of the College of Business and Economics. To assess the effectiveness of the program a certification in computer competency is to be given to all seniors in the College beginning with the 1996/97 academic year. In the process of developing the certification examination the College needed to know the level of computer competency of students entering the College as well as the level of computer competency that was expected of graduates by potential employers. With this information the College would have defined a beginning point and a set of concrete objectives. The tactical plan for getting from one to the other consisted of the redesign of the College core curriculum.

DETERMINING COMPUTER COMPETENCY OF THE ENTERING STUDENT

In the spring term of 1994 a survey was distributed to 385 students in the first year courses of Business, Accounting, Economics, Marketing, and Finance. The survey consisted of demographic data as well as questions on the use and understanding of the DOS operating system, programming fundamentals, and selected advanced topics such as INTERnet and UNIX.

The demographic results are shown in Figure 1. The computer competency attributes of the sample are shown in Figure 2. The profile of the student who is highly computer competent is shown in Figure 3.[1] These results are consistent with a recent study reported by the American Council on Education.[2] The practical use of the results are used in both curriculum development and design of the senior certification exam for computer competency, Figure 4.

LEVEL OF COMPUTER COMPETENCY EXPECTED BY POTENTIAL EMPLOYERS

A forum of regional employers together with College faculty and the College Board of Advisors met in fall, 1994 to discuss the strengths and weaknesses of college graduates as perceived by employers. Computer competency skills ranked at the top of the list of areas that needed improvement which was consistent with similar employer reports.[3][4][5] The emphasis was to develop those skills which provided the student with the knowledge of how to respond to change, particularly technological change. It is insufficient to teach a student how to use a specific word processing, spreadsheet, or database package, instead, the student should be taught the essential functions and concepts of generic business application tools. For example, knowing the basic MS-DOS commands does not help a new employee cope with the UNIX system of his/her employer unless he/she has been taught and understands the concepts of operating systems. The ability to transfer knowledge is key in the development of a curriculum that will be effective for 21st century graduates. Furthermore, computer applications should be presented as tools used in the solution of business problems, not ends in themselves.

THE INTEGRATIVE APPROACH TO BUSINESS CURRICULUM DESIGN[6]

The result of consultation with stakeholders in the College was the development of a core curriculum that would address international critical thinking, ethical, and hands-on computer use in problem solving.[7] This curriculum assumes a degree of

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[5]Stevens, J., "Creating a Partnership for Educational Excellence," Journal for Quality & Participation, Vol: 16, Iss: 1, Jan/Feb 1993, p: 48-50.

[6]McCallister, L., Rowell, D. and McCubbin, K., "Computer Literacy: The Possible Efficacy of Integrative Teaching Methods," A research proposal submitted to BAA Research Award Program School of Business Administration, St. Mary's University, San Antonio, Texas, August, 1994.

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universality and transferability with respect to business skills. In addition to successful completion of the general education requirements the BSBA degree requires selection of a major and the completion of the following courses:

(1) MATH 125 - Introductory Statistics
(2) CPSC 205 - Introductory Business Computer Concepts
(3) ACCT 201-202, 410 - Introductory Accounting and managerial Accounting
(4) ECON 201-202 - Micro and Macro Economics
(5) 18 credit hours in the major field and concentration
(6) 30 credit hours in the Business Core Courses

THE BUSINESS CORE

BUSN 300. Foundations of the Business Enterprise

Prerequisites: none.
Corequisites: ACCT 201 or ECON 201. Fall.
This course will provide a balanced understanding of the business environment and its role in society. Capital formation and usage, production generation and distribution, and managerial process requirements are covered. ***A computer simulation*** module in the laboratory component of the course allows the student to actively engage in decision making and problem solving and provides feedback to the student on independent variable manipulation.

BUSN 311. Principles of Marketing (3-3-0)

Prerequisite: ECON 201, 202, ACCT 201-202
Fall and spring.
An introduction to basic marketing principles and analysis of the marketing system, its operations and the mechanism of these operations relative to the consumer, products, channels of distribution, pricing and promotion. Special attention will be given to the practices, problems and decisions of the marketing manager with an emphasis on ethical implications. Students will perform ***course assignments requiring computer applications***, critical thinking and global perspectives BUSN 323. Financial Management (3-3-0)
Prerequisites: ACCT 201-202. Fall and spring.
Topics include the environment of managerial finance, financial analyses, planning and control; working capital management; investment decisions; valuation and cost of capital; and long-term financing.

BUSN 323 Financial Management

Prerequisites: ACCT 201-202. Fall and spring.
Topics include the environment of managerial finance, financial analyses, planning and control; working capital management; *computer simulation of a variety of investment decisions*; valuation and cost of capital; and log-term financing

BUSN 331: Statistics in Management Decision-Making

Prerequisites: MATH 125, CPSC 205. Fall and spring.
Emphasis is place on computer-assisted decision making in a variety of business settings which are national and international in scope. Creative interpretations of practical business and economic problems including ethical issues involved in the design and collection of sample data. Students examine decision making under uncertainty using classical hypothesis testing, analysis of variance, contingency tables, non-parametric studies and the use of regression equations.

BUSN 341: Introduction to International Business

Prerequisites: ACCT 201-202: BUSN 300,311, 323. Fall and Spring.
Addresses the problems created by operating a business in more than one country. Involves the

topics of international economic Theory, international capital markets, marketing and market structure, international trade organizations and legal systems, international finance, exchange rates, and balance of payments. International business cases are analyzed. Cross cultural and ethical variables between nations are discussed. *Business cases address the impact of information technology on international business strategy.*

BUSN 361: Legal Environment of Business

Prerequisites: ECON 201, 202, junior standing. Fall and spring.

Intense overview of business law, governmental regulation, contracts, torts, sales (U.C.C.), litigation, alternative disputes resolution, agency, creditors' and debtors' rights, bankruptcy, labor law, employment law, the Americans with Disabilities Act, consumer protection law, anti-trust and monopoly, environmental law, financial transactions, forms of business enterprise, and *intellectual property and computer law.* The American legal system as well as a framework for international business law is presented. Student assignments are designed to elevate awareness of business ethics, resolve dilemmas, and communicate clearly in the context of the complex business environment.

BUSN 362: Using Technology for Decision Making and Solving Business Problems

Prerequisite: CPSC 205 or permission of instructor. Fall and spring.

The identification of managerial and organizational information needs. Describes the role of Management Information Systems in the functional business areas including current professional practices, technology, and methodologies. *Projects include hands-on information systems problem solving and involve one or more of the following: spreadsheet analysis, decision support systems, reengineering issues database applications.*

BUSN 400: Organizational Behavior

Prerequisite: MGMT 324. Fall and spring.

A detailed investigation into contemporary organization theory and *problems including the effect of automation.* The determinants of organization design, the structural, ethical and process components of an organization, determinants of organization performance, and interrelationships between organization context, structure, process and ends. Alternative theories and models of domestic and international organizations will be compared and contrasted.

BUSN 408: Quantitative Analysis for Business and Economics

Prerequisites: MATH 125, CPSC 205

Corequisite: BUSN 331 Junior or senior standing. Fall and spring.

A description of the management science approach to management decision-making. Mathematical models are used in lieu of subjective reasoning to cope with business decision situations. *Problems involving complex business analyses requiring computer solution are assigned.* Quantitative models covered might include probability study, linear programming, inventory control, queuing theory, simulation, decision theory, and Markov chains. Also covered is liability responsibility for flawed data bases leading to inaccurate results.

BUSN 418: Strategic Planning

Prerequisites: ACCT 201-202; BUSN 300, 311, 323, 331, 361, 362, 400, 408; MGMT 324. Fall and spring.

The capstone course in Business Administration that involves analysis and formulation of actual business cases. International operations and aspects are analyzed with respect to strategic positioning. *Software packages are used as analytical tools.* Individual and team presentations are given in both oral and written form. Ethical dilemmas are identified and discussed.

ADAPTING THE CORE TO CHANGING TECHNOLOGY

The advantages in the design of the core courses will disappear unless the College also designs a viable process of adapting the core to changing technology. The process as shown in Figure 5. is a dynamic feed-back system: the annual computer competency census results together with analyses of the previous year's senior computer competency exam are used as the basis of discussion between the faculty of the College and the Board of Advisors of the College. The faculty use information from this discussion to modify the computer tools in the core courses. For example, such a discussion motivated the upgrade of decision support application software to distributed group decision systems in the Organizational Behavior course. These changes in computer tools are then reflected in the senior computer competency certification exam, and possibly also, in the annual census instrument.

Conclusion

The rate of change of technology as it applies to business must be considered in business curriculum design. The stakeholders in the institution are the major reason for the existence of a business program and their perspective of the curriculum should be taken into account. Furthermore, there must be a dynamic process for adapting the curriculum in response to changes in business technology and the demands of the increasingly sophisticated workplace.

INTERNSHIPS: A BRIDGE BETWEEN THEORY AND PRACTICE

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ABSTRACT

The rapid technological advancements in the computer field have created many problems for employers, academic institutions, and CIS/MIS graduates of those institutions. This paper describes how one university has developed an internship program which has been successful in overcoming many of these problems.

INTRODUCTION

The rapidity with which new models of computer hardware and new versions of software packages are introduced has made academic programs very vulnerable to having their curricula lag significantly behind both the technology and how it is used.

One of the primary reasons for this vulnerability is the rapidity with which computer hardware and software packages become obsolete. These changes in technology have also had a great impact on the needs of the information systems professional. For example, "Today we see a multitude of new job titles in this arena that did not exist ten years ago (e.g., database analysts, user support analysts, office automation specialists, EDP security/auditing specialists, and telecommunications/ networking specialists)" (3).

According to Shorter and Dean, if students are to be prepared for careers in computing, an academic program must keep up with new technology (4). Although our department is proud of our attempt to prepare graduates for most of the new job titles mentioned above, the rapidity with which technological changes take place makes it extremely difficult to keep curricula up-to-date. It is not unusual for colleges and universities to have a lead time of one to two years for curriculum revisions and new courses.

Another problem is related to budgetary constraints that are being imposed on most institutions of higher learning. In a time of major budget cuts and "downsizing," it is virtually impossible for colleges and universities to provide the latest hardware and software to support their curricula.

The rapid obsolescence of hardware and software also creates other problems in terms of keeping faculty up-to-date and trained on the use and application of the latest hardware and software in the computer industry.

Major computer users are also facing problems of their own because of the pressures of doing business in a global economy and the recent economic recession that has taken place in the United

States. These factors have forced many organizations to reevaluate how they have been doing business. Because personnel costs are often one of the largest single budget items of doing business, many companies have decided to freeze all hiring. Other companies have taken a more severe approach to the problem by laying off employees through a technique often referred to as "downsizing," while still other businesses have been forced out of business altogether or consolidated or merged with others. Regardless of the nature of the action taken, the end result is the same; fewer job opportunities.

Although personnel downsizing is taking place, the demand for computer-based systems has not been diminishing. Instead, companies are finding the backlog of requested computer systems to be getting longer and longer while the number of computer personnel is getting smaller and smaller. In addition, the MIS Departments are also being asked to provide service to more and more end users as their companies move from the traditional mainframe-based environments to distributed computing (often referred to as client-server) environments. Many of the existing computer personnel do not have the necessary knowledge of the new computer hardware and software technology required to undertake many of the new system requests. To compound the problem, the budgetary constraints under which many MIS Departments are working makes it very difficult, if not impossible, to provide the training needed by present personnel. For that reason, when employers do recruit, they look to colleges and universities with a curriculum that utilizes new technology and emphasizes current practices (1).

These same organizations are also facing many of the same problems as educational institutions in terms of changing technology and hardware and software obsolescence.

Because of the rapidly changing technology, CIS/MIS students are facing their own challenges. They are finding that course content and curriculum requirements are constantly changing in an attempt to remain in touch with the "real world." This means that students are faced with the choice of graduating with skills that are becoming obsolete and/or delaying graduation one or more terms so they can enroll in some of the new/modified courses.

Graduates of CIS/MIS degree programs find themselves entering the work force today at a time when many people with years of computer experience are unemployed because of corporate downsizing. Graduates are finding that employers are placing a heavy emphasis on prior computer work experience. I refer to this problem as the "chicken and egg syndrome." How are students to gain experience if nobody will hire them without the experience?

If industry projections are accurate, the problems described above are expected to continue into the 21st century. What then is the answer? Although not a total solution, a properly run internship program can help solve many of the problems being faced by all three entities: the business employer, the CIS/MIS graduate, and the educational institution.

STUDENT INTERNSHIPS

Many academic institutions offer two types of student work-experience programs. These are called "cooperative education" and "internships." Although these programs are similar, they usually operate differently, thereby serving a different segment of the student population. Many colleges and universities use the term *cooperative education* to describe a work/study program where a student alternates between working full-time and attending classes full-time. In this type of program, the student might alternate between working and attending classes on a term-by-term basis; or the student might work for six months to a year prior to returning to classes.

The term *internship*, on the other hand, is often used to describe a program in which students work part-time while continuing to make progress toward their degree objective. As might be expected, this often means that the student is enrolled in less than a full load of classes/units each term. Either or both terms may be used to describe the work-experience program(s) offered by an academic institution. In many cases only a single program is available, either cooperative education or internship, but that program may include both types of employment opportunities—both part-time and full-time.

For the purposes of this paper, the term "internship" is used throughout for all types of work experience that are recognized for credit by the academic institution.

OPERATING PROCEDURES FOR THE INTERNSHIP PROGRAM

Any student who is presently working in a computer-related job may apply for (request) credit for that experience. In instances where students are not working in a position which qualifies for CIS internship credit, the internship coordinator will assist those students who wish to obtain work experience in the computer field. This assistance involves three primary functions: (1) maintaining a bulletin board listing available jobs, (2) interviewing and prescreening student candidates for specific job openings, and (3) serving as a referral service once student qualifications and interests match an employer's needs and specified qualifications.

Most job listings are obtained from local employers who have hired graduates and/or interns in the past. In some cases, the employer is a graduate of our department and may even have been an intern while a student. Because of its reputation and history of producing highly qualified graduates, our department has become the primary source of entry-level CIS personnel for many companies. The internship coordinator also maintains a high profile with DPMA chapters in the area, often serving as a speaker or resource for educational programs.

Position vacancies are posted as soon as they become known to the internship coordinator. The job posting describes the duties to be performed, number of hours/days per week, qualifications/skills desired by the employer, and geographic location. No mention of employer or company name is included on the posting.

Students who are interested in obtaining employment referrals through the department must submit a completed internship application and current resume. When those documents are on file with the coordinator, students may request more information about any posted job. The coordinator then reviews the student's interests and qualifications in terms of stated employer desires. If a match is found, the student is given information about the employer and instructions on applying for the position. In some instances, employers request that a cover letter and resume be mailed or faxed to them. In other cases, students are given a phone number and are asked to call the employer to schedule an interview. Regardless, the final hiring decision is left with the employer.

Students and employers are both asked to report back the results of the interview process. This provides important feedback to the coordinator, who may not be aware of important selection criteria that the employer is using but forgot to mention earlier.

DETERMINING AMOUNT OF CREDIT EARNED

Once the decision has been made to include an internship program as part of the CIS curriculum, specific guidelines and/or rules must be developed to assure that students are receiving similar credit for similar work. The amount of credit earned should also be reflective of the learning value of the internship experience. These guidelines, once developed and adopted, serve as the Standard Operating Procedures (SOP) for internships regardless of the person assigned as Internship Coordinator.

For the reasons stated above, our department uses a formula (see Figure 1) to arrive at the amount of credit earned by each student intern. Since implementing the formula approximately 15 years ago, we have eliminated virtually all complaints from students about the number of units of credit given for their experience. The use of the formula has removed most of the subjectivity that had been involved and has made it possible for the internship coordinator to be much more objective in awarding similar credit for similar learning experiences. The credit earned is based on three factors: average number of hours worked per week, depth of knowledge/difficulty associated with duties being performed, and amount of opportunity for new learning to take place. The form, "Formula For Internship Credit" is used to determine the number of units of internship credit to be earned during the present term.

FORMULA FOR INTERNSHIP CREDIT

Total Credit Points = (H + D) * N

1. **H = Average Hours worked per week during term.**

Less than 10 hours per week	= 1 point
10 - 19 hours per week	= 2 points
20 - 29 hours per week	= 3 points
30 - 39 hours per week	= 4 points
40 or more hours per week	= 5 points

2. **D = Depth (learning value) of experience)**

Data Entry (mini/mainframe systems)	= 1 point
Microcomputer Operator	= 1 point
Programmer (SS, Dbase, BASIC, etc.)	= 2 points
Mini/Mainframe Operator (batch shop)	= 2 points
Programmer Trainee (procedural lang)	= 3 points
Mini/Mainframe Operator (on-line)	= 3 points
Programmer (large systems)	= 4 points
Programmer/Analyst Trainee	= 4 points
End-User Support	= 4 points
Telecommunications Specialist	= 5 points
Systems Analyst	= 5 points
IS Auditor	= 5 points
MIS Mgt Trainee (large shop)	= 5 points

3. **N = Newness of Experience**

Basically the same as previous term	= 1 point
Majority of experience is new	= 2 points
Experience is totally new	= 3 points

INSTRUCTIONS TO COMPUTE UNITS EARNED

Add point scores from Sections 1 and 2. Then multiply that sum by the point(s) from Section 3 to determine "Total Credit Points." Use the following chart to determine UNITS earned.

2 - 5 Total Credit Points	= 1 Unit
6 - 9 Total Credit Points	= 2 Units
10 - 15 Total Credit Points	= 3 Units
16 - 21 Total Credit Points	= 4 Units
22 - 27 Total Credit Points	= 6 Units
28 or more Total Credit Points	= 8 Units

Figure 1

First of all, it is important to determine what type of work experience is worthy of university credit. Our CIS faculty is of the opinion that virtually any computer-related work experience has some value. That would include work as a data-entry clerk, word processor in a large organization, computer operator, or whatever. For example, we are convinced that a student who performs data entry tasks will be exposed to many valuable learning experiences. These experiences may involve work with hardware and software that is not available in the classroom, as well as a wide variety of applications and different types of controls. In many cases, students will have an opportunity to apply previously learned concepts to a real-life situation.

Although this type of experience is believed to be worthwhile, it is not the type of internship experience that is preferred by students or the department. Most of the CIS internship positions described above are filled by freshmen and sophomore students who have not yet completed many CIS courses. For most upper-division students, those who have completed the first half of the required CIS courses, internships involving programming, systems analysis, network (LAN) management, and use of multimedia are highly desired. These types of internships provide a direct transition to full-time employment for many students after graduation. Our experience is similar to that reported by the College Board which administers standardized tests and conducts public policy research on education issues. According to the College Board, ". . . employers are tapping 80 percent of their student interns for permanent jobs" (2).

It must also be recognized that the amount of learning that takes place on the job is dependent on numerous factors and that job titles are not always indicative of what the intern will really be doing. Rather than merely relying on job titles, procedures must be in place to help identify what the intern is actually doing.

Another important factor in determining the amount of credit earned by a student intern is the number of hours worked per week. Few people would question the statement that the more hours worked on the job, the greater the learning value of the internship. Therefore, any procedure for determining credit should also factor in the number of hours worked per week.

A third, possibly more subjective, factor that is used to arrive at the number of units earned on an internship relates to the "newness" of the experience. As an example, consider a student working as a programmer trainee responsible for maintaining a COBOL program for the marketing department of a large company. The intern is responsible for adding, deleting, and/or changing the program as products and/or prices change. Assuming that this program uses a large two-dimensional price table, most people would agree that the student intern will have an opportunity to learn a great deal in this position. But, what if the student comes back the next term and his/her job duties have not changed but are still limited to maintaining the same COBOL program. Is the potential for student learning the same the second and succeeding terms? We do not think so. If that is the case, then the amount of new learning that is taking place each and every term must be considered in determining the amount of credit that is to be earned on a particular internship.

EVALUATING INTERNSHIPS

Unlike most courses where instructors have regular contact with students, students enrolled in our internship program have but two required meetings with the internship coordinator each term. The first meeting is during the first week of the term when the student officially requests consideration of credit for his/her work experience. During the initial meeting, the internship coordinator completes the Formula for Internship Credit Form shown in Figure 1 to document where the student is employed, what duties are being performed, etc. Based on that information and the calculation of the credit formula, the student is enrolled in the appropriate number of credit units for the term.

Periodically throughout the term, the internship coordinator contacts the employer to determine how well the intern is performing his/her assigned duties. During that conversation, the coordinator attempts to identify any problems that the student may be having. Of special interest are any comments about knowledge and/or background the intern was expected to have, but doesn't. That information provides valuable input to the department's curriculum review process and also to the coordinator when attempting to fill a similar position with the company in the future. There are fewer midterm contacts with employers where a long-term working relationship has been established. In those cases, the channels of communication are so well established that follow-up is done on an exception basis.

The second required meeting with each intern takes place at the end of the quarter when the student is required to submit a written report about his/her internship experience. Although not a lengthy report, the report requirements force student interns to become better acquainted with the company in which they are working.

SUMMARY

An internship program can help overcome many of the problems presently being experienced by academic institutions, employers, and students. A properly designed internship program is a "win-win" situation for all parties involved: the academic institution, the employer, and the student.

The benefits of an internship program from the perspective of the university include:

- Providing a real world test of the educational program
- Supplementing classroom learning
- Providing access to expensive resources
- Providing a ready market for the product (graduates) of the program
- Motivating student interns as they see the relevancy of course requirements

The benefits of an internship program from the perspective of the student include:

- Gaining valuable work experience

- Having an opportunity to explore different career areas (tracks) within the computer field with no long-term commitment required

- Being able to reflect internship credit in three ways on a resume: as CIS courses/units completed, as work experience, and in grade point average (GPA)

The benefits of an internship program from the perspective of the employer include:

- Having a ready source of "skilled" applicants who have been prescreened by the university

- Having an opportunity to test employees without a long-term commitment

- Gaining an inexpensive source of motivated employees

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AUTHOR'S NOTE: Copies of all documents referenced in this paper will be available as handouts at ISECON'95 or they can be obtained by writing to the author.

Successful Application of Principle Centered Leadership in the Information Systems Project Course

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Abstract

The senior IS project course is a final opportunity to refine the skills needed by entry level professionals. In addition to the technical aspects of the discipline, the ability to interact with colleagues and clients and to work constructively on teams are important for development in the course. The concepts of principle centered leadership and its application in the course environment are presented.

Introduction: IS Curriculum and the Project Course

Information Systems curricula are designed to enable students to "*develop confidence and competence in the necessary skills to be successful in current and future IS environments*" (Couger et al 1995). Since the major goals of the curriculum, IS'95, are the development and deployment of information systems, the senior project course (see Figure 1) gives a unique capstone opportunity for students to develop or refine applications level skills (Longenecker et al 1995) within the discipline.

Expectations and Explanation of the IS Project Course

1. This is the capstone course for IS majors who have completed the systems analysis and design sequences. It focuses on engaging in and completing a major system development project, thereby completing the coordinated four course project sequence begun in IS'95.7.
2. Within the project context, management of IS and systems integration are explicit requirements that students address.
3. The project is a team effort and allows a final opportunity to practice personal and interdependence skills to help ensure team member empowerment and success. Project management tools will be employed by the team to help ensure tracking of the project and communication of project goals and accomplishments to the client.
4. CASE may or may not be used depending on resources. Project standards will be developed for all life cycle and other actions. Software quality assurance methodologies will be employed to help ensure a successful outcome for the project.
5. On-going presentation of project planning, analysis, design, conversion plan, and other documentation will be done by the team. Each team member plays a significant role in the presentation.

Figure 1 - IS'95 Expectations for the Information Systems Project Course (Longenecker et al 1995).

The special nature of the IS discipline in recognizing the necessity for and developing "people skills" has been a central plank of the curricula since the first information systems curricula (Ashenhurst 1973; Couger 1973; DPMA 1981,1985,1986; Nunamaker 1982; ACM 1983; Longenecker and Feinstein 1991; Gorgone et al 1995; Longenecker et al 1992,4,5). Sprague (1993) captures the spirit of this challenge well by referring to the major obligation of information systems "*to improve the performance of people through the use of information technology...where the ultimate objective is performance improvement...where the focus is the people who make up the organization...*"

While development and deployment of systems is a goal of information systems professionals (Trauth 1993; Mawhinney 1994), there is an additional strategic obligation to deliver such systems within the context of a successful environment involving people working to achieve the goals of their organization (Steenis 1990; Ahituv 1993)..

Objectives of the Project Course

IS'95 defines the project course as follows: "*Advanced IS majors operating as a high-performance team will engage in and complete the design and implementation of significant information system. Project management, management of the IS function and systems integration will be components of the project experience. This course covers the factors necessary for successful management of system development or enhancement projects. Both technical and behavioral aspects of project management are discussed.*"

Figure 2 summarizes the expectations of an IS graduate who is the product of the curriculum and specifically the project course The project course gives students and faculty a final opportunity to work together before graduation to ensure that the issues covered within this figure are addressed within the context of an enterprise level project.

1. **System theory and Quality** ... principles and methods of system theory; effectiveness, efficiency, quality; Quality... quality concepts, planning and tools, and participation in the process of continuous improvement as it relates to the enterprise; mission, vision
2. **Functions of organizations and management**... functioning of organizations, to support the organization's principles, strategy, goals, and objectives; management planning and application techniques, issues, and tools
3. **Project management**... concepts of project management, life cycles, performance and specification metrics, team methods; costing, projecting and tracking; risk management
4. **Decision making**... Principles and concepts; providing essential support to management for decision making in the organization
5. **Accountability**... providing reliable, cost-effective solutions that satisfy formal standards for performance, capacity, reliability, security, and safety (IEEE; ISO 9000; Federal, state, and local laws; etc.); concept of standard practice
6. **Personal quality and ethics**... proactive behavior, goal setting and personal decision making, time management, continuous learning and personal development, confidence, adaptability; rigorous effective completion of agreements; possessing and setting a high ethical standard
7. **Ability to communicate**... oral, written, and multimedia techniques; communicating in a variety of settings; empathetic listening, principle centered leadership
8. **Interacting with Others** ... interacting with diverse user groups; facilitating obtaining information necessary for solution of organizational systems, negotiating win-win agreements, synergistic solutions, and empowering others
9. **Team participation**... working and solving problems as a team member
10. **Theory**... underlying principles that apply to computing, including mathematical definitions and axioms, theorems, proofs, and interpretation of results
11. **Modeling and abstraction**... data modeling and collection; hypothesis formation; event modeling, simulation and prediction; experiment design; measurement; analysis and interpretation of results
12. **Methodology**... disciplined and measurable process control techniques and tools for managing system and software development efforts, and for assuring quality, cost effectiveness, and adherence to standards
13. **Design**... conceptualization and realization of systems in the context of real-world constraints, including system requirements, specifications, auditing/control, design and implementation, testing and analysis, conversion and operation
14. **Data communications and computing hardware**... principles, concepts, architecture, media, networks, devices, standards and protocols, system requirements and specifications, configuration, installation, integration, operation and management
15. **Database management systems**... principles, concepts; event definition, expectation and measurement; conceptual/logical/physical modeling and model interconversions, specification, DDL, DML and development, configuration, installation, integration, operation, security and maintenance
16. **Programming and Software Development**... principles, concepts, modularity, objects and ADTs, data structures, algorithmic design, verification and validation, cohesion, coupling, language selection, user interface design, documentation (program, development and user level) and configuration management, installation, module and systems integration, testing operation strategies and procedures

Figure 2 - IS Curriculum Exit Objectives (Abstracted from IS'95: Longenecker al 1995).

Traditionally, the project course has focused on the application of project management to the systems development and deployment process. We strongly support these goals; however we also recognize that a paradigm shift is occurring towards the concepts of successful leadership based on a system of principles stated by Covey (Covey 1989,91). These principles recognize the inherent value of people and develop compatible organizational structuring methods to realize this awareness. This represents a greatly improved approach to traditional management(see Figure 3). Covey refers to this process as principle centered leadership (PCL). The applicability of Covey's concepts, or at least the interest in his ideas is evidenced by the best seller status of his books, and by the growth of his organization which promotes his ideas and practices to thousands of organizations. PCL is based on applying the habits of interdependence to individuals who can successfully and reliably choose actions supportive of effective interpersonal interaction. This paper focuses on our interpretations of the PCL concepts and our application within the senior project course. Our application of PCL is compatible with the specifications of IS'95 (Longenecker 1995; Couger 1995) which recognizes this requirement (see Figure 1, item 6) .

Principle Centered Leadership

Steven Covey in a series of three books (Covey 1989, 1991, 1993) has outlined a paradigm for individuals and organizations which, according to Covey, is appropriate for those who desire to become successful. Peter Denning addresses the need for students of computing to address these issues and incorporate them into their work(Denning 1992). Denning speaks of the necessity to listen, commit and then complete work. Covey addresses these same issues and provides general guidelines for their implementation.

Habits of Character Strength	Activities and Attitudes to Work on During the Course
Be Proactive	Be in control of personal actions Evaluate problem situations NOW, seek solutions according to correctness of standards Identify what is personally solvable and do it now Make personal decisions and take action now Avoid blaming; take responsibility; accept + and - feedback
Begin With The End in Mind	Determine personal short and long term goals Determine outcomes in project activities and meetings before beginning Ensure there is involvement of others to ensure shared vision of outcomes Recognize and choose actions commensurate with desired outcomes and goals
Put First Things First	Plan and choose to work on important things now Plan to avoid crisis level work Do it now, don't put off the important for the urgent unimportant things Do what is yours; delegate others work to others, and ensure an effective work-flow
Habits of Interdependence	
Think Win-Win	Look for and accept only approaches and solutions beneficial to all parties Celebrate success of others; Support the achievements of others Resolve conflict; be fair; control self-interest Do not compromise others performance or ethical situations Ensure all are involved in decision process Ensure resources, measurement, meaningful standards, accountability, timeliness
Listen First to Understand, then be Understood	Listen with mouth shut; be empathetic Be sensitive and show it; accept, tolerate and celebrate diversity Resist immediate personal solutions of others problems Understand and express issues of team and those related to team Communicate clearly, and efficiently personal views confidently without dominating
Synergize	Look for better ways incorporating all views and skills Seek diversity of views; seek informed consensus Build relationships and teams; encourage others Find ways to reward others as individuals, and as teams

Figure 3. The Basis for PCL: Practicing the Habits of Independence (Character Strength) and Interdependence in the IS Project Setting.

The idea is that there are a set of principles or irrefutable truths which if learned and then applied will enable individuals to develop sufficient character strength that they will be able to choose to participate interdependently with others to achieve larger shared goals. Figure 3 is a presentation of character strength and interdependent habits Covey defines. His postulate is learning the first three habits ensures a degree of independent action. He asserts that these habits must be learned in order, because each builds on the previous habits. Covey further asserts that successful interdependence comes after mastering the first three habits and with learning the interdependence habits.

Covey asserts that individuals with high character strength and who are also knowledgeable are trustworthy. This condition is illustrated in Figure 4. Management can place its "trust" in these individuals to take-on and complete work. These individuals have the technical competence, as well as the character strength to make a commitment to complete work. The commitment comes from the ability to recognize what is important, and to allocate sufficient time to finish the work free from a crisis environment.

Independently capable individuals may be "empowered" to do their work. There is no need to check on them because of their character strength. They will, in Denning's words, "rigorously complete" their tasks. However, to be really effective, the work of individuals, as well as the work of teams, must be consistent with higher organizational expectations. Covey asserts that this condition can best be achieved by the action of "alignment" of team or individual missions with those of the organization. In this condition, both management, teams and individuals have a shared vision of what needs to be done. Covey further asserts that this can only happen with trusted employees who have learned and are capable of practicing the habits of interdependence.

The habits of interdependence involve the belief that there will be solutions in which all stake holders needs and desires will be fulfilled. Covey refers to this as a "win-win" approach. Individuals, teams and organizations must be committed to this objective. However, to develop the "necessary shared vision" effective communication has to take place. The Harvard negotiation project made similar

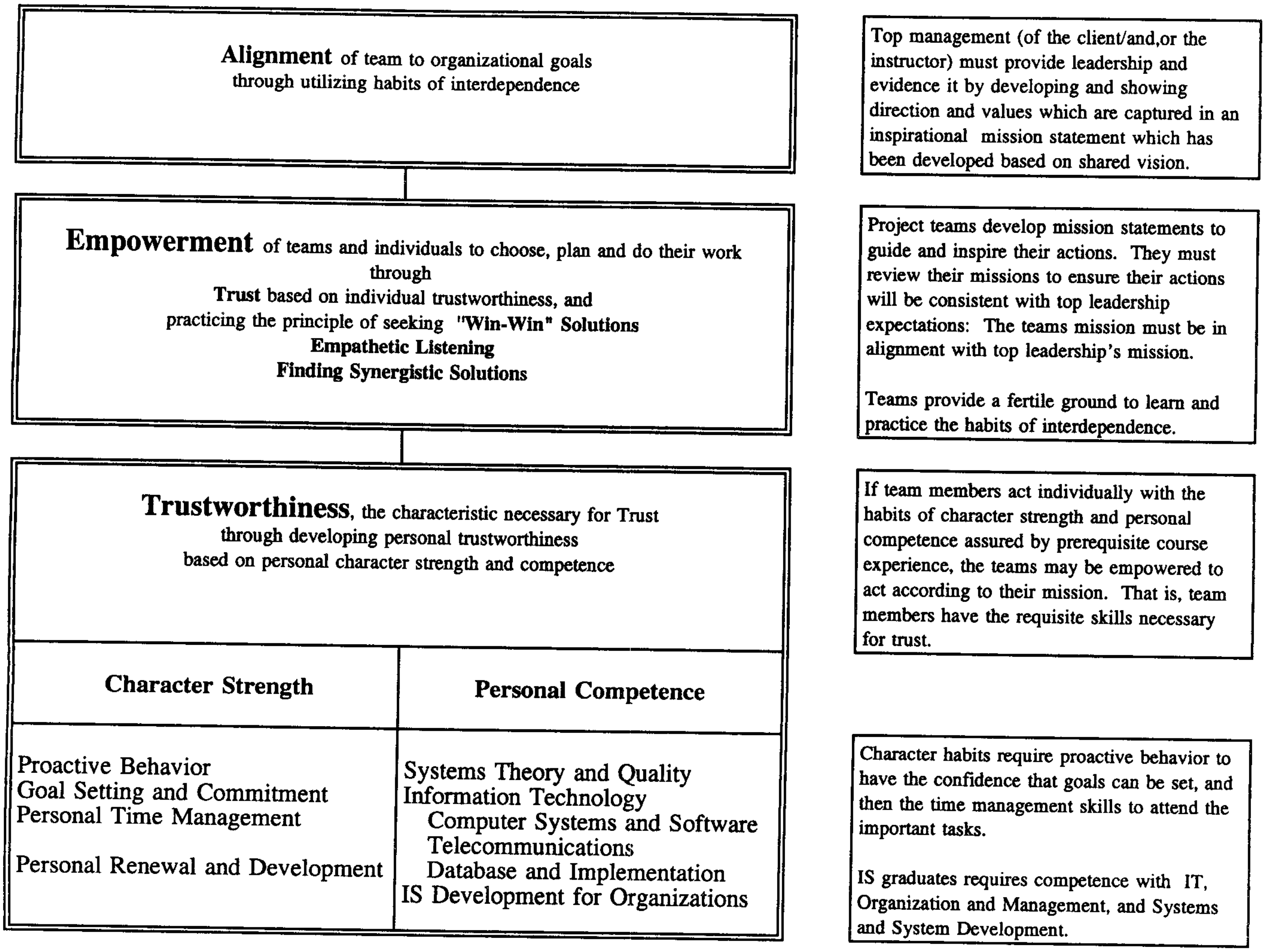

Figure 4 - Principle Centered Leadership (PCL) in the Project Course.

findings which have been utilized in successful negotiation strategies (Holland College 1993). The idea is that based on a culture in which there is the perception there will be a win-win agreement reached. This also suggests that empathetic listening will give the basis for finding a synergistic solution. The right column of Figure 4 represent approaches that we ask our students to consider.

Since IS as a discipline is geared toward the success of people in organizations, as is the Covey PCL paradigm, we feel it is important for our students to be exposed formally to these PCL issues. Team oriented courses give a good opportunity to learn and practice the concepts. We have explored the utility of PCL concepts in our IS curriculum and discuss and use the concepts in several courses. The concepts have been introduced in the "Principles of IS" course, IS95.3. We have utilized the paradigm in our applications course sequence (Daigle and Kemp 1994, 1995), the equivalent of IS95.5 & 9, as well in the "Systems Analysis and Design course", IS95.7 & 8. In our IS program, each of these sequences involves teams. The PCL concepts are appropriate to these courses. The most significant use of the PCL concepts is in the capstone project course.

We have conducted the project course in two modes (see Figure 5) involving multiple simultaneous individual team projects, or one large project involving the entire class. These approaches represent more the interests of the instructors. Both approaches have had considerable success. PCL has been used successfully in both implementations. Students, in general, respond with a great deal of enthusiasm. The projects take on more of an aspect of fun as opposed to a more sterile class room environment (See Holland College 1993 for alternate project model for first two years!). Projects that have involved real clients in which there is real risk as well as a real opportunity for success. This situation helps motivate the students. It is not uncommon for students to spend in excess of 20 hours per week doing productive work on the projects.

Areas of Consideration	Project Type	
	Un-Coupled , Several Small	Closely Coupled, 1 Large
Team Operation	Independent teams	Coordinating Team, Stable work teams, ad hoc activity groups
Management	Team Leaders	Project Manager & Associates Team and activity leaders
Mission	Independent missions	Project Mission Aligned Team Missions
Team Composition	Membership on one team	Multiple team memberships Some stable, some ad hoc
Work Commitments	Project Centered Controlled by team	Activity Centered Responsibility with teams Project Logging/Monitoring Client Focused & Controlled
Projects	one per team, some client focused, some team focused	multi-project, single or multiple client based students work mostly on project phase need
Tools	usually one particular tool or facility as per team requirements and interests	multiple tools, multiple languages as needed to serve client interests
Standards	instructor furnished, or ad hoc, but generally student interpretation of instructor expectation with instructor review & monitoring	formal written standard for all activities; instructor directed, student developed and enforced including formal work-flow, with QC and grading
Instructor Role	Guide in software development Monitor of standards Coach in Presentations	role model in client interactions expert and consultant initiating standards facilitator in project management leader and encourager
Presentations	Formal at phase boundaries Final presentations before audience	As necessitated,continuously as per standards Daily formal reports Continuous walk-thru's in teams Weekly project reviews with/without client
Documentation	Project Management Systems Development End User	Project Management Systems Development End User
Documentation Review	Periodically at checkpoints	Continuously at the completion of each activity for all documentation. Weekly for project management data
Sample Projects	Finger Print Analysis Internet Navigator Geographical Information System Job Search System Student Advising System	City Employee Quality Metric City Procurement and Payments City Action Center and Dispatching Child Day Care Centers Management University Advising and Scheduling
COMMON APPROACHES	OLD PARADIGM	NEW PARADIGM
Engaging in work	You are assigned to do ... I'll let you know when it's time to think..	Would you be willing to agree to do ... How can I support your interests
Empowerment Issues	You got this....wrong! You idiot! Do it this way! Do it the way I tell you to do ...! You fit in here ... ! Got it! I'll give you this grade for ... this way! Life is unfair, Suck it up! Learn this .. or else	What are you trying to do? What might make the situation better? How can I help you? Could your team align itself with... Can you define, measure and account.. How can we develop fairness rules for all.. What skills can I assist you in acquiring...

Figure 5 - Similar and differentiating factors for two project approaches. Single and multi-project methodologies were utilized and represent successful approaches to implementing the project course. Common approaches are compatible with PCL.

Covey defines the PCL environment as a far more challenging and rewarding environment that the standard hierarchical model. We are considerably impressed with the seriousness of commitment and high degree of excellence achieved by student project members and student team leaders. The higher the challenge and the more we truly utilize the PCL script (Figure 3 and Figure 5, Common Approaches), the better have been the results.

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Is there an IS Paradigm: and who cares anyway?

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ABSTRACT

"Information Systems" is a widely accepted and used term, both in industry and academia. However, there is much academic debate regarding the subject matter of information systems and the status of the discipline. This article presents a brief review of the literature assessing the status of the discipline in terms of the existence or otherwise of an Information Systems paradigm. It then presents observations, drawn from IS literature which illustrate the IS paradigm. The paper concludes by identifying implications for researchers, educators and practitioners and by proposing an item for further research.

INTRODUCTION

"Information Systems" is a widely accepted and used term, both in industry and academia. However, there is much academic debate regarding the subject matter of information systems and the status of the discipline; are there "meaningful problems or effective, reliable methods for solving them."[1] is there some coherence between research and researchers within the discipline, and to what extent is there "a set of dominant philosophical assumptions or a **world view** that informs the work of researchers in [the] discipline"?[2]

BACKGROUND

A number of authors argue that Information Systems Research is clearly in its infancy. Farhoomand, for example, in 1987 stated that "MIS has not made significant progress as a scientific discipline"[3]. Tricker supports this view maintaining that the paradigms of information and its management remain as ambiguous and ephemeral as ever"[4], as does van Gigch who writes that "The Information Systems (IS) discipline lacks a paradigm to guide its work."[5]

At the same time, Orlikowski and Baroudi maintain that Information Systems Research "does exhibit a single set of philosophical assumptions regarding the underlying nature of phenomena being investigated, the appropriate research methods to be used, and the nature of valid evidence."[6] and other recent publications provide some evidence to suggest that the field is emerging as a scientific discourse. [7]

What is a paradigm?

It is useful to consider what a *world view* or a *paradigm* might consist of. References to paradigm generally refer back to the work of Thomas Kuhn.

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[1]Klein, Hirschheim and Nissen, 1991

[2]Orlikowski and Baroudi, 1991

[3]Farhoomand, 1987

[4]Tricker, 1992

[5]van Gigch, 1989

[6]Orlikowski and Baroudi, 1991

[7]for example, Klein, Hirschheim and Nissen, 1991

Kuhn himself uses the term somewhat loosely, but it can be summarised as "the complete constellation of beliefs, values, techniques etc., shared by the members of a scientific community."[8] A paradigm consists of the implicit or explicit views of reality, the core assumptions, and the *exemplars* or exemplary items of research or publication, shared by the community (in this case Information Systems). A paradigm includes the historical tradition within which researchers work and which is itself re-defined by those researchers. Other authors use related terms including "*Weltanschauung*" [9], "*World View*"[10], "*Disciplinary matrix*"[11], "*Perspectives*" and "*a priori views*"[12].

The existence of a paradigm "account[s] for the relatively unproblematic character of professional communication and for the relative unanimity of professional judgment".[13] An approach becomes a paradigm if, and when, it is accepted by the majority of members of the community. Paradigms are supported by education programmes which initiate students into the community through exposure to the existing views of, and the exemplars held by, the established membership. The paradigm evolves over time. "It undergoes *evolution* rather than *revolution*, as scholars and practitioners influence what is being produced, written, and studied."[14] Radnitzky supports this evolutionary model stating that "The fore conceptions about the territory and the perspective they implicate are the earmark of a research enterprise or a research tradition. They will be evolving; but they cannot be drastically changed without the research tradition losing its identity."[15]

[8]Kuhn, 1970

[9]Checkland, 1981

[10]Orlikowski and Baroudi, 1991

[11]Farhoomand, 1987

[12]Visala, 1991

[13]Kuhn, 1970

[14]van Gigch, 1989

[15]Radnitzky, 1972

Is there a paradigm for information systems?

"Ever since prehistoric antiquity one field of study after another has crossed the divide between what the historian might call its prehistory as a science and its history proper"[16] and further, "it remains an open question what parts of social science have yet acquired such paradigms at all. History suggests that the road to a firm research consensus is extraordinarily arduous." [17] Has Information Systems Research *crossed the divide?*

Keen argues that Information Systems is a "self-defined community, not a 'field' or 'discipline'."[18] Information Systems exists because those involved perceive that it exists. He notes the lack of *exemplars*; the books, the core readings for Ph.D. students and the "examples of outstanding research in many styles and on many topics"[19], but he does put forward examples of research which he himself believes to be "classics of ISR". Orlikowski and Baroudi on the other hand, examined 155 ISR articles (published between 1983 and 1988) and found that "although this research is not rooted in a single overarching theoretical perspective, it does exhibit a single set of philosophical assumptions regarding the nature of the phenomena studied by information systems researchers, and what constitutes valid knowledge about those phenomena"[20] .

[16]Kuhn, 1970

[17]Kuhn, 1970

[18]Keen, 1991

[19]Keen, 1991

[20]Orlikowski and Baroudi, 1991

Lyytinen introduces the term *paradigmatic villages* and talks of information systems as a *multi paradigmatic community*.[21] Banville and Landry, similarly refer to information systems as a *fragmented adhocracy*; a discipline characterised by areas of cohesive thought, but lacking an overarching paradigm.[22] Keen also emphasises the breadth of the discipline, choosing to see this breadth as a strength rather than a shortcoming.[23]

Perhaps the most insightful statement comes from Kuhn himself, who describes the pre-paradigm period as being "regularly marked by frequent and deep debates over legitimate methods, problems, and standards of solution, though these serve rather to define schools than to produce agreement."[24] The level of debate over the status of an IS paradigm, itself indicates that no such shared paradigm can be taken for granted.

OBSERVATIONS

IS addresses an identifiable research field

Much Information Systems research addresses issues relating to the development and introduction of systems based on information technology. In this research there is increasing emphasis on the social nature of the systems development process. (Lyytinen, 1987a; Newman and Robey, 1992; Jon Turner, 1982). There is much interest in the role of the user in the development and implementation of information systems. (Rathswohl, 1991; Kuuti, 1991)

There appears to be a move, in terms of the focus of Information Systems Research, away from a concentration on the development of information systems towards a consideration of the social impact of information systems on organisations and on society in general - The study of information systems is seen as a social science. As early as 1980, Kling stated that "When computing is embedded in a complex social setting, it becomes a social object, and development and use of computer-based services a social act."[25] Coupled with this is some indication that the subject matter of Information Systems is becoming broader. Mumford, for example, claims that "researchers were moving away from systems design to an interest in the structural and social consequences of an increasingly pervasive I.T."[26] and Achterberg (in particularly dramatic tone) "We are obliged to confront the wider implications of I.T. for the quality of life, working environment, and in a more serious tone, the whole survival itself."[27]

There is some consensus regarding the general subject matter of ISR.

While there may be some discussion about the detail, and certainly there is much debate about the status of information systems research, there would appear to be a consensus regarding the general subject matter of the field. Information Systems research is concerned with investigating "the social processes surrounding the introduction, creation, use/misuse/disuse of information technology"[28]. This is a broad area of study, which overlaps other fields of study. Figure 1 adapted by Nolan and Wetherbe (from Davis and Jensen 1974) is an early example of a representation of this concept. One could argue that IS is entirely encompassed by other fields. Keen supports this view, but responds by claiming that Information Systems is a self-defining discipline; it exists precisely because its membership perceive that it exists.[29]

Curricula define IS

Paradigms are constantly redefined by the education process. Many IS curricula have now been developed, most of them recently. Hudson et.al. noted that of the IT related courses offered in Australia in 1991, over half had commenced after 1985. Several reviews have also been produced which summarise these and/or make recommendations regarding what should be included in IS curricula. (Buckingham et.al.,1987; Hudson et.al, 1992).

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[21]Turner, Bikson, **Lyytinen**, Mathiassen and Orlikowski 1991

[22]Banville and Landry, 1989

[23]Keen, 1991

[24]Kuhn, 1970

[25]Kling, 1980

[26]Mumford, 1991

[27]Achterberg, 1991

[28]Orlikowski and Baroudi, 1991

[29]Keen, 1991

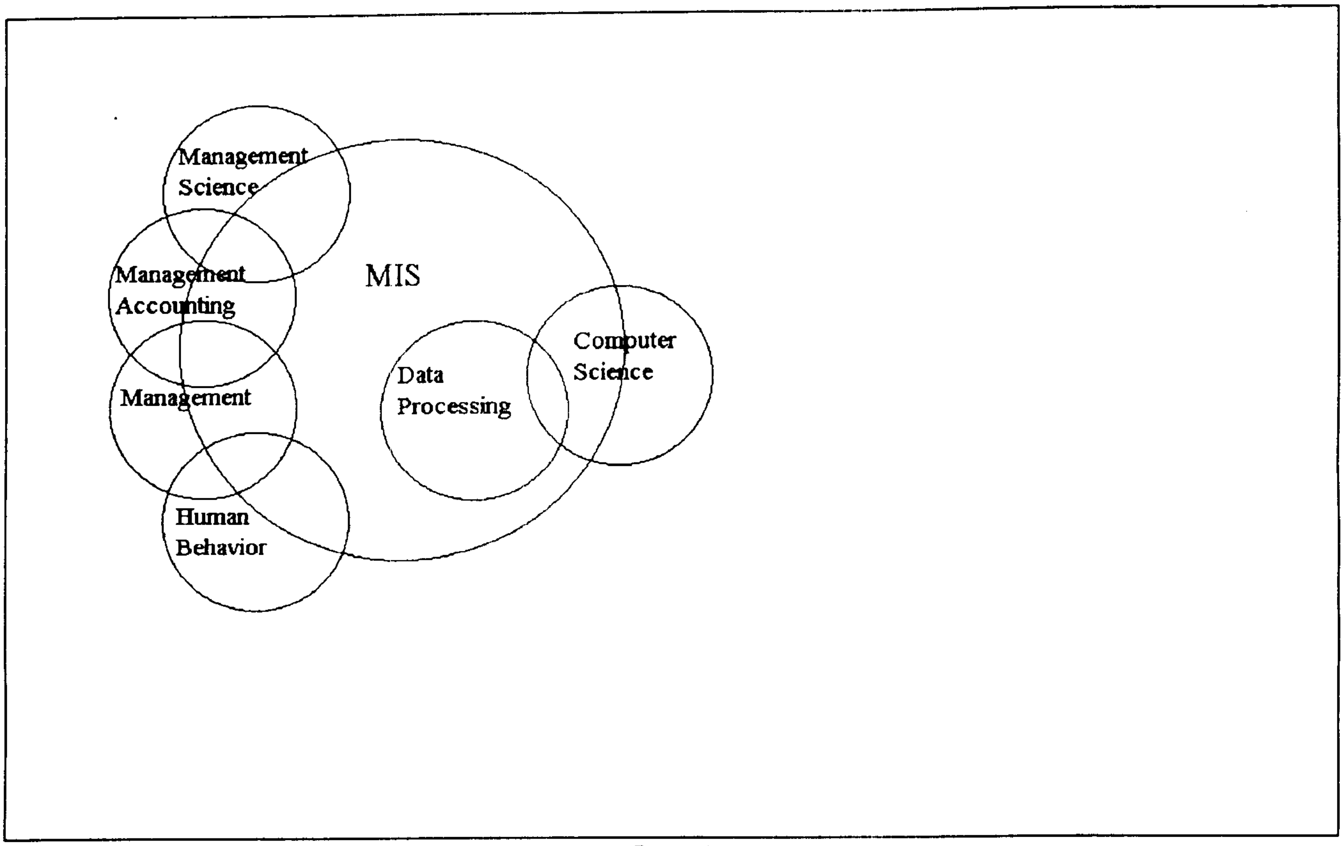
Management
Science
Management
Accounting
MIS
Management
Data
Processing
Computer
Science
Human
Behavior

figure 1

These indicate that there is considerable variation in IS curricula.[30] However certain themes are seen to emerge. The Hudson Report includes an Australian Computer Society figure which identifies both the content of, and the context for the IS curriculum. A derivative of this diagram is included as figure 2. The additional feature, is that the content of a particular degree (The Bachelor of Applied Information Systems, from Manawatu Polytechnic) has been mapped onto the figure. This illustrates a level of consistency between the programme and the ACS framework.[31]

IMPLICATIONS (OR, WHO CARES ANYWAY?)

It is possible that IS should not be looking for paradigms in a scientific sense. In his explanation of paradigms, Kuhn distinguishes between "the sciences" and "fields like medicine, technology, and law, of which the principal raison d'etre is an external social need"[32]. IS may well fit into this category. Certainly Achterberg would appear to support this argument when he states, "IS research has a different set of concerns. It is closer to those of practice-based disciplines like engineering and management, as well as soft disciplines like psychology and sociology"[33].

However, whether or not we choose to use the term paradigm, there are reasons why the IS community needs a shared set of assumptions about the nature of the general problem domain (notwithstanding differences regarding focal points within that domain), about what constitutes valid knowledge about that domain, and what methods are appropriate for the gathering of that knowledge. The need, is not so much to create a place for IS as to recognize the place it already occupies so that the efforts of the community can be better directed.

[30] e.g. Hudson et.al. 1992 p9

[31] This framework was not known to the degree developers until after the curriculum development process was completed

[32] Kuhn, 1970

[33] Achterberg, 1991

Implications for Researchers

Research is a collegial undertaking. Researchers feed off communication with, and the findings of fellow researchers. A paradigm sets the ground rules regarding acceptable methods within the field, but perhaps more importantly, it provides a focal point around which researchers work. The presence of such a focus allows for more effective direction of research efforts (Nolan and Wetherbe, 1980).

Implications for Educators

Paradigms are both defined and supported by education programmes. These programmes themselves contribute to the growth of the paradigm. If IS is to develop, in terms of research and practise, it is important for IS educators to develop and communicate a clear understanding of the subject and its relationship to its neighbours.

Graduates need to be prepared for a future as either a researcher or a practitioner. Employers should know what to expect from IS graduates. (And there are certainly grumblings that there is a gap between employers expectations and experiences.[34])

Further, a shared understanding of the subject is a precondition if a coherent curriculum is to be explicitly delivered. If students are to make 'connections' between papers within a subject, and even more so, if they are to make connections to related disciplines, then IS educators need to be conscious of the focal point(s) of the discipline and the relationships (dare I say 'interfaces') with the rest of the curriculum.

Implications for Practitioners

Information Systems practitioners increasingly need to justify their existence. In the days of Data Processing, the role of the DP department was relatively straight forward. All computerised processing of data was the responsibility of the department. In these days of End User Computing and Outsourcing this is no longer the case. Information Systems professionals need to be quite sure what their role is and what they have to offer the organisation.

[34] see for example Hudson, 1992

Information Systems and Related Disciplines

based on an Australian Computer Society submission to the "Report of the Discipline Review of Computing Studies and Information Sciences Education"

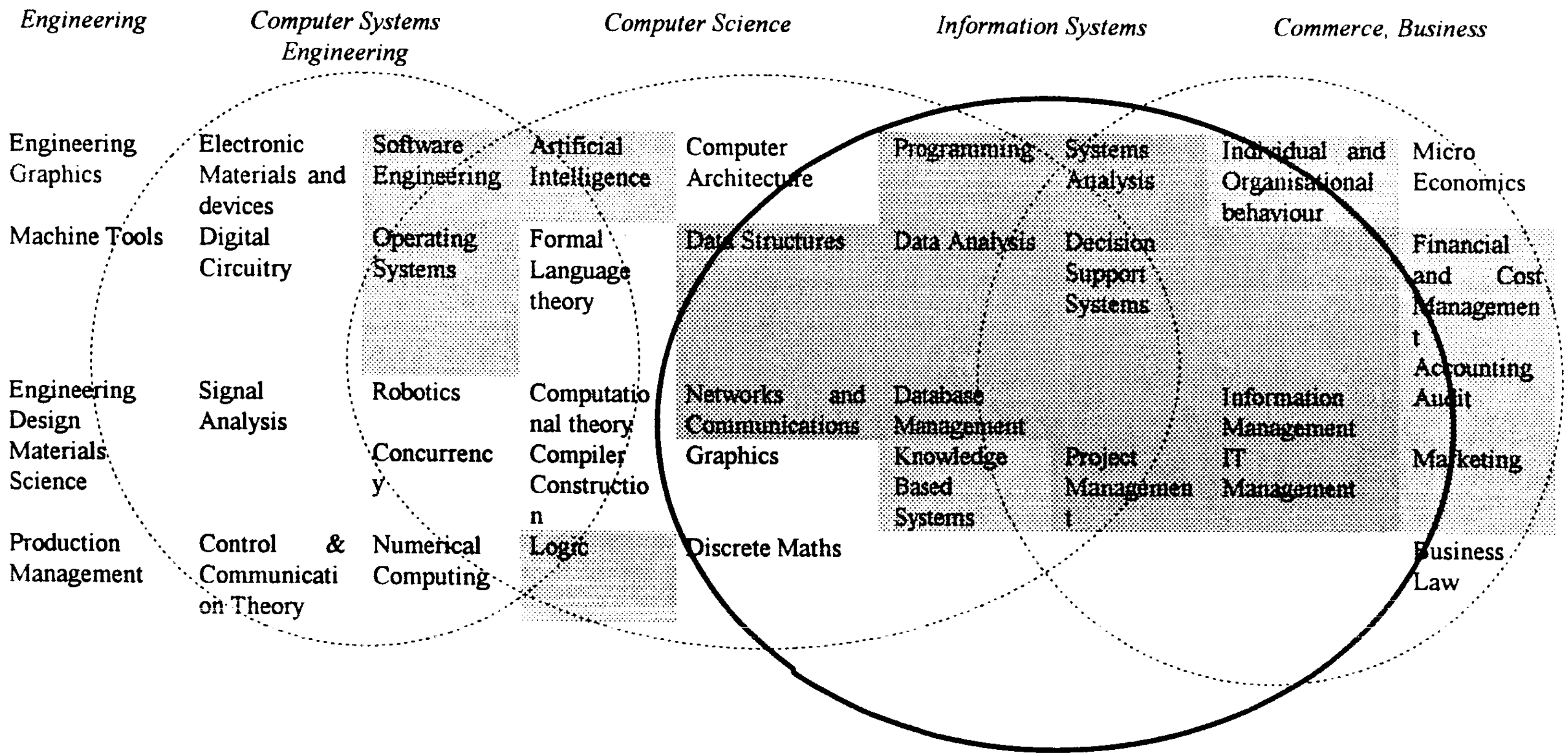

figure 2

Implications for All

Education, research and pactice cannot be divided off into unrelated spheres of influence. They each influence each other (see figure 3). Research influences education, education redefines the paradigm, practise provides the purpose for much of (at least) the research (given the orientation of the discipline outlined above).

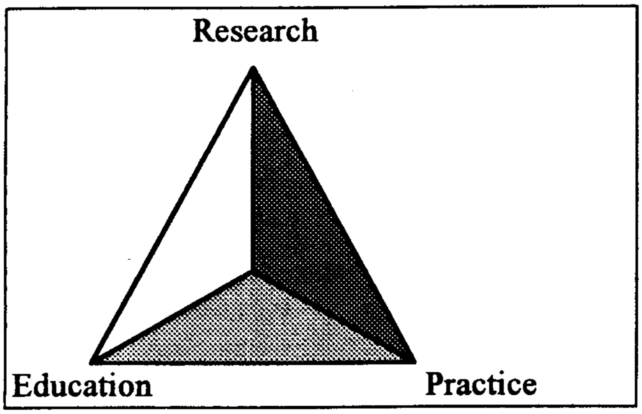

figure 3

A critical issue, and subject for further research, is whether a shared paradigm exists within the IS community, or whether separate paradigms are developing (or have developed) between academia and practitioners.

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Using Competency Based Education to Deliver Information Systems Education

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Abstract

There must be a commitment to provide quality education for students. This commitment should show a desire to provide students with valid skills; a realization that the development and management of a competency based instructional system is going to take time and effort; a willingness to accept assistance and advice from colleagues who have had success with the system; and a determination that you can and will make the system work.

INTRODUCTION

The central idea underlying Competency Based Education (CBE) is **Competence** - being able to do something and do it well. The emphasis shifts from knowledge testing to performance testing. Testing mastery of facts, knowledge, concepts, principles, terminology, and theory still has a part in CBE, but is secondary to testing a student's ability to perform. Knowledge is an enabler that helps the worker perform. What really matters in CBE is whether the student can measure up to the requirements of the occupation. Evaluation is criterion referenced and the criteria used are the standards of performance expected of beginning workers in the occupation.

The principles of CBE are based on Bloom's model for mastery of learning which contains the following:

- Any student in a training program can perform most tasks at a high level of mastery if provided with quality instruction and sufficient time.
- A student's ability to learn a task need not predict how well the student learns the task.
- Individual differences in levels of mastery of a task are more frequently caused by inadequacies in the learning environment rather than by characteristics of the student.
- Most students become very similar to one another in learning ability, rate of learning, and motivation for learning when provided with favourable learning conditions.
- Educators should focus more on differences in learning and less on differences in learners.
- The most important element in the teaching and learning process is the kind and quality of instruction experienced by students.

This paper will discuss the two components that are used at to deliver the DPMA Model Curriculum using a performance based method of evaluation, the main elements of this method are:

1. DACUM - Developing a Curriculum
2. CBE - Competency Based Education

1.0 DACUM

Develop A CUrriculuM, is a methodology for analysing an occupational field in terms of its relevant **Areas of Competencies and Skills**. The analysis process takes approximately two to three days to complete and results in a two dimensional spreadsheet called a **DACUM CHART**. The **DACUM CHART** visually organizes the occupational field into a spreadsheet of **Areas of Competencies** and their corresponding **Skills**.

The success of this development effort depends heavily on the involvement of industry representatives who build the chart over a three day period in a formal meeting called a Chart Committee Meeting. This meeting takes the overall format of a Brainstorming session under the leadership of a facilitator. The committee identifies the Areas of Competency and then the individual skills within that area. The areas of competency are general enough to encompass a range of skills. For example "Design and Code Programs" as an Area of Competency might contain thirty individual skills. Through this development process the Chart Committee takes ownership for the result of their efforts. This result is a complete occupational analysis and identification of essential skills needed in a given field.

Once the field is fully defined the Chart Committee is then prepared to take a subset of skills and group them into an Occupational Profile. There may be several profiles within a given field. For example within the Information Processing field there may be Programmer/Analyst, User Support Specialist, and Business Applications Programmer identified as occupational profiles.

The Chart Committee will then determine the minimum entry level performance ratings for each skill. By specifying minimum requirements, this is their statement that they will hire graduates at or above the skill level that they are requesting. The committee is driving the process and therefore will have a sense of ownership for it.

The DACUM Chart is then maintained on a yearly basis through Advisory Committee meetings. This committee advises the faculty on trends, changes and overall level of satisfaction with the program's graduates, resources, and focus of training for the coming year.

1.1 Philosophy

The philosophy of DACUM is based on three main principles:

1. Expert workers are better able to describe and define their occupation than anyone else.
2. Any job can be effectively and sufficiently described in terms of the skills that successful workers in that occupation perform.
3. All skills have direct implications for the knowledge and attitudes that workers must have in order to perform the skills correctly.

1.2 Advantages of DACUM

Several advantages of DACUM are:

1. Provides a detailed task analysis for an occupation or working department.
2. Enables you to make program revisions in response to economical and technological changes in the workplace.
3. Develops and sustains a cooperative relationship between educational institutions and industry.
4. Provides the basis for the development and delivery of competency (performance) based training to meet individual learner needs.

2.0 Competency Based Education Model

Most learners experience Culture Shock when first encountering Competency Based Education (CBE). This institution believes that Competency Based Education represents a substantial change from the traditional education approach of classes, lectures, and tests. The years of experience with the traditional approach have formed strong preconceptions about the roles and responsibilities of students and educators. Competency Based Education challenges many of these preconceptions. Consequently, new learners need an understanding of CBE in order to function effectively with it. They need to develop some *survival skills*. For this reason, new learners undergo an extended orientation to the institution and CBE. They are gradually weaned from the traditional lecture/exam approach to learning. They develop skills for managing their own learning. Learning Management skills include skills in communicating, planning, organizing, scheduling, and time management. Such skills are essential survival skills for CBE.

The new learner orientation period usually lasts from 3 to 4 weeks. Various attitudes and expectations are explored about the roles of learners and learning managers. Learners participate in role plays and activities that give them some working experience with the approaches of Developing a Curriculum (DACUM), Self Training and Evaluation Process (STEP) and Competency Based Education (CBE).

Some of the advantages for students include:

- Being given credit for prior learning
- Being able to proceed at his/her own rate within program guidelines.
- Having a choice in how he/she learns
- Accepting more responsibility for his/her own learning.

- Competing against established standards not other students.
- Being graded on achievement of standards or criteria for each segment of the curriculum.

Some of the advantages for the instructors include:
- Being allowed to become a facilitator of learning and not the sole source of all information.
- Being able to concentrate on student motivation and instilling confidence in the learner.
- Being able to work alone with individual students in order to design personalized curriculum.

Some advantages for Administrators include:
- Uses instructional staff, equipment, and facilities more efficiently.
- Makes articulation of secondary to post secondary and part time adult instruction easier to accomplish.
- Accommodates community educational needs for skills retraining and upgrading.
- Increases opportunities to work cooperatively with industry.

Following orientation, learners plan and manage their own learning. They assume responsibility for their own learning, using the Phased Profile Manual (PPM) as a guide to analysing, planning, organizing, and scheduling their learning. The Phased approach to manage learning is built on the same principles used in developing computer systems, which uses phases of the Systems Development Life Cycle Model. A useful way of thinking about competency Based Training is to remember that:

Telling is not teaching, hearing is not learning.

2.1 Individualized Learning Management

2.1.1 Enabling and Empowering Learners

The institution seeks to *ENABLE* and *EMPOWER* learners to learn. Enabling new learners means teaching them the skills to work together as a team. Learners are equipped to function with greater freedom and responsibility for their own learning. They are trained to use the methods and tools of the training program to manage their learning. We enable the learner during the orientation phase.

Empowering new learners means *TRUSTING* them to play an integral role in the training program. It means extending the *RESPONSIBILITY and AUTHORITY* to each learner to participate actively in the entire learning process. Each learner becomes a resource to the whole department. As they acquire skills and exercise leadership their contribution becomes increasingly significant. Learners are empowered throughout the remainder of the course.

By enabling and empowering learners, the training program seeks to make each learner a valuable contributing part of the learning experience for all learners. The Goal is to bring a *unity to the diversity* of backgrounds, skills, and abilities of new learners. When this happens, learning becomes meaningful and fun. Motivation comes from within rather than without. The sum of the pieces becomes greater than the whole.

Once enabled and empowered, learners use the *PHASED REVIEW PROCESS* as a guide for managing progress toward common goals.

The PHASE REVIEW PROCESS provides the means to manage Unity with Diversity.

2.1.2 The Phase Review Process

The Phase Review Process is a method for *CLUSTERING* and *SEQUENCING* skills into *PHASES*. It is also a method for defining generalized learning *GOALS* for each cluster of skills. It gives the learner and the learning manager a common context for evaluating progress against goals. Much like the development of computer software systems, each phase must be formally signed off to be completed.

The PHASE REVIEW PROCESS is a tool for monitoring learning activities.

Under the Phase Review Life Cycle Process, an occupational PROFILE is divided into PHASES. A PHASE is a functional grouping --cluster-- of *SKILLS, and MILESTONES* within the occupational profile. Each phase addresses a particular set of goals. Phases are sequenced such that each phase builds upon the skills and experience of the preceding phase. Dividing the profile into phases is important to:

1) Help the learner to relate the skills, activities, and resources with the profile to tangible goals.

2) Give the learner short term goals to achieve. Goals that clearly relate to the long term profile goals.

3) Provide major checkpoints against which learners and learning managers can measure progress and provide significant feedback.

Learners must complete their current phase before proceeding to the next phase. Learners must complete each phase on or before their scheduled completion date. All of the phases together make up the life cycle of the profile.

2.2 Phased Profile Manual
The handbook given to each learner, the Phased Profile Manual, includes a *PHASE DESCRIPTION* for each phase. Phase Descriptions provide the *RATIONALE* for the phase and identify the associated responsibilities.

The Phased Profile Manual (PPM) describes the curriculum for learning a given occupation within a field . There are many occupations in the Information Processing field, for example, Business Application Programmer, Programmer/Analyst, or End User Support. There is a PPM for each occupation for which training is currently being offered.

Each Phased Profile is made up of a subset of the Business Information Processing DACUM chart skills. These skills have been identified by industry as essential to gaining employment in that occupation.

The Phase Profile Manual (PPM) groups related skills together in clusters. These clusters are logically sequenced to guide learners from basic skills to the more complex skills. The PPM provides contextual information about each cluster of skills and their relationship to the overall profile.

The PPM is a management tool for both learners and learning managers. As such, the PPM provides the framework within which learners analyse, plan, organize, and schedule their own learning. It provides a consistent means for monitoring progress and providing feedback in the development of skills throughout the course.

The Phased Profile Manual (PPM) follows the Phase Review Life Cycle Model used extensively in business for managing software development projects. The Phase Review Life Cycle Model aids the learner in defining and managing the details (when and how) of their learning schedule.

The Phased Profile Manual (PPM) may be thought of as a conduit which channels the learner without rigidly defining the *how* of learning. The *how* is largely defined by the learner and learning manager using the PPM as a guide.

The PPM approach provides learners with valuable experience using the Phase Review Life Cycle methods. Thus, project management skills used for learning management are directly transferable to the Business Information Processing field.

2.2.1 Highlights of The Phase Profile Manual
The main sections of this document contain descriptions of the PHASE and phase MILESTONES for each phase of the profile. The PHASE and MILESTONE descriptions help learners perform a PHASE ANALYSIS on their current phase. They set the context for the skills, activities, and resources in the phase. They help the learner to keep the big picture in view while zeroing in on the details. *MILESTONES* give the contextual meaning to the specific activities and skills within the phase.

MILESTONES signify major learning GOALS within a PHASE.

When a group of learners enter a new phase, they begin by reviewing the PHASE and MILESTONE descriptions in the PPM. This helps each learner to determine the context of the phase and the profile.

Understanding the context is vital to determine the breadth, depth, and scope of learning required. It also helps the learner gain a sense of purpose and accomplishment. The learner sees where they are, how far they've come, and how far they have yet to go.

2.3 The Phase Analysis

The phase analysis is an analysis performed by a group of learners at the beginning of each phase. The phase analysis interprets the requirements of the current phase. The phase analysis team identifies, locates, and reviews related resources. They then develop a phase plan for the group.

The phase plan is called the *THE PHASE ANALYSIS DOCUMENT*. This document is used by the group to schedule the remainder of the phase. It provides them with information about available resources, and helps them to coordinate activities and resources with the rest of the group and department.

The phase analysis begins with learners organizing themselves into a phase analysis team. The team then works to determine the requirements, deliverables, constraints, dependencies, etc., for planning and scheduling the analysis.

The phase analysis team *BRAINSTORMS* an outline of the phase analysis document and decides how they will proceed with the analysis. The team makes decisions about what has to be done, who will do it, and how it will be done.

During the *brainstorming sessions*, various tasks are identified and a plan and schedule are prepared. The plan and schedule are then reviewed and approved by the phase manager. Once the plan has been approved, the group produces the phase analysis document on schedule.

The phase analysis team works with the learning managers to determine specific requirements for the phase. Requirements include lectures, projects, and learning activities that will help them complete the phase. They interview people, review resources, and present their results. Final results are compiled into the phase analysis document. Draft copies of the phase analysis document are reviewed and approved by the phase manager until a final draft emerges.

2.3.1 The Phase Analysis Document

The PHASE ANALYSIS DOCUMENT is a document used by each learner to schedule their phase. It is produced by the learner for the learner. It interprets the general phase requirements outlined in the PPM into a more detailed phase plan. The format and content of the PHASE ANALYSIS DOCUMENT is determined by the phase analysis team and varies from one analysis team to another.

The coordination of projects, activities, and resources all depend on the quality of the phase analysis. It is extremely important that each learner does their best to participate and contribute to the phase analysis.

Failing to plan is planning to fail!

2.3.2 The Phase Analysis Post Mortem

The phase analysis post mortem is a positive self-examination of the phase analysis. It has one purpose: to help learners learn from their experiences. The post mortem identifies in bullet form, what went well, what didn't go well, and any ideas for improvement.

Post mortems are a powerful tool for appraising learning experiences. They assume a common goal for self-improvement. Post mortems are most effective when conducted immediately following an activity or project.

The phase analysis post mortem is scheduled immediately following the completion of the phase analysis. The results are mailed electronically to the learners in the group and faculty. Copies of the post mortem are kept on file by the phase manager for future reference.

Failing to communicate is communicating failure!

2.3.3 Phase and Learning Schedules

Using the PHASE ANALYSIS DOCUMENT, learners individualize their learning schedules to suit their own needs and preferences except where it is expedient to coordinate their schedules.

The learning manager reviews and approves learning schedules. The learner is held accountable for their progress under the approved schedule. Learning schedules must fall within the profile and phase schedules.

The learning manager may approve justifiable changes to learning schedules. Phase schedule changes are approved by the head instructor. Justifiable changes include: illness, accident, death in the family, and other such events.

Other schedule changes may be approved providing that the learner informs their learning manager sufficiently in advance to make alternative arrangements. ***There should be no surprises.*** A surprise occurs when the learner informs their learning manager at the last minute that they need an extension. Approved schedule changes are noted in revised versions of the original schedule.

Every journey has a beginning and an end.
If you don't know where you are going
you won't know when you've gotten there!

2.3.4 Phase Reviews

A PHASE REVIEW is a formal assessment of the learners progress at the end of a phase. Phase reviews are conducted by the learning manager. Learners making unsatisfactory progress are placed on probation by their learning manager according to the program's Policies and Procedures.

2.4 Performance Ratings

PERFORMANCE RATINGS are a measure of the learners competency in performing a given skill. Performance ratings are based on an industry standard rating scale.
The Performance Rating Scale that is used is as follows:

1 **Can perform some parts of this skill satisfactorily but requires assistance and/or supervision to perform the entire skill.**

2 **Can perform this skill satisfactorily but requires periodic assistance and/or supervision**

3 **Can perform this skill satisfactorily without assistance and/or supervision**

4A **Can perform this skill satisfactorily with more than acceptable speed and quality**

4B **Can perform this skill satisfactorily with initiative and adaptability to special problem situations**

4C **Can perform this skill satisfactorily and can lead others in performing it**

The concept behind this rating scale is that if one were to rate the performance of skills by workers in any occupation, one would find some skills performed at a high level of expertise, and many at an acceptable level, and some below the level for which an employer is prepared to pay. The ratings used in this method of evaluation denote a level of skill development rather than a measure of knowledge.
Performance is rated against the performance of someone already employed in the field, not against the performance of a fellow learner in the program. Performance Ratings may change, increase, or decrease with time. They reflect the current performance levels for skills.
MINIMUM PERFORMANCE RATINGS are required for all skills on the profile. Minimum performance ratings are determined by an Industry Profile Advisory Committee.

A PHASE is complete when the learner has received the MINIMUM PERFORMANCE RATINGS for all phase skills and has completed all phase projects. Phase skills minimums are often less than occupational profile skills minimums. The Learning Managers determine phase skills minimums to reflect the progressive nature of skills development.

> *The PROFILE is complete when a learner has received the minimum PERFORMANCE RATINGS for all profile skills.*

Conclusion

The faculty have found that students differ significantly in the length of time it takes to adapt to a learning philosophy which gives them a great deal of freedom but which demands a great deal of responsibility from them. Certainly, mature students adapt more readily. The critical moment seems to occur when students realize that they will progress only when they themselves do something. After they get used to the system, students progress beyond the usual levels of competence, both personal and technical, in amazingly short periods of time.
Despite occasional problems and frustrations encountered by faculty and students, surveys conducted to date indicate that few desire to return to a more conventional system of education.

Multimedia: Is Academia Lagging Industry?

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ABSTRACT

A review of popular computer-related publications indicates that the multimedia technology has already been readily accepted by the business sector to support key business functions such as: training and learning, sales and marketing, and business presentations. Although multimedia are now starting to make their way to some of academia's more prestigious publications, there is some level of controversy surrounding the importance that MIS academicians and scholars place on multimedia. This paper attempts to assess whether MIS academia is lagging industry in the level of importance placed on multimedia concepts and technology.

INTRODUCTION

Over the past few years, multimedia technology has definitely begun to make solid organizational impact within specialized segments of the business sector. Multimedia technology has been used to enhance and support a number of key business functions, including employee training and learning, business presentation support, and business sales and marketing. Much of this phenomenal growth within companies and organizations can be attributed to the availability of multimedia authoring software and support systems for personal computers that have flooded the information systems market within the last few years. This multimedia explosion has not escaped the attention commercial computer publishing industry. Most popular computer related publications today carry a plethora of articles on multimedia concepts and technologies, as well as, advertisements of multimedia products. This technology has even spawned the development of new publications like Multimedia and IEEE Multimedia that are dedicated to only multimedia features and articles. The growing popularity and acceptance of this emerging technology has not solely been limited to the business arena. Multimedia systems are now slowly making their way out of the office and into the academic laboratory and classroom. Since it has been found that in the field of management information systems (MIS) that theory very often lags practice, it is not surprising that research into multimedia is now just reaching the fore front of academic publishing. Although multimedia articles are now starting to make their way to some of academia's more prestigious publications, there is some level of controversy surrounding the importance that MIS academicians and scholars place on multimedia. Is multimedia really is a harbinger of change, or just another passing "here today and gone tomorrow" technological fad? Is this just an industry phenomenon or is it equally important to academia? Why is it that academia has been slow to embrace research into this popular technology? The purpose of this study is to determine whether academia is lagging the industry in terms of the attention paid to multimedia concepts and technologies.

Objective

The objective of this paper is to determine if MIS academicians have been slow to accept multimedia as a legitimate information systems technology requiring theoretical research and analysis. Though there are a number of possible methods that might be used to gauge the level of importance placed on multimedia by college and university MIS researchers, probably one of the best measures is the total number of articles published in academic journals. Does that number compare to the number of articles published in some of the more widely read trade journals?

This article examines the articles published in the leading eight (8) and other academic MIS journals over the period January 1987 - December 1994 and compares them to articles published in popular trade journals of the same period. This analysis will help to establish whether academia is really lagging industry in embracing the current and future benefits of multimedia technology.

Methodology

The first step in this research involved an extensive review of articles on multimedia and hypermedia in an effort to arrive at a working definition. This was followed by the identification of the leading academic journals in MIS by analyzing the findings of previous studies that had rated journals in MIS. Other academic journals and trade journals were selected for review based on their representation in on-line databases. ABI/INFORM™, an on-line database marketed by University Microfilms Inc (UMI), was the database used for this research. The use of on-line databases and ABI/INFORM™ in particular as a research tool has been well established.

A comparative study of the proportion of multimedia articles published in each of the aforementioned classes was then carried out and an effort was made to determine whether there is a significant difference in the attention received by multimedia from each of these classes. Articles were classified as relating to multimedia if a review of the article revealed that the predominant topic was multimedia related and if the on-line database used for the research listed multimedia on the subject list for each of the articles.

Overview of Multimedia

Multimedia is the integration of text, graphics, animation, audio and video in a computer readable format. Hypermedia can be defined as a navigational tool that allows users to access inter-related materials from a database that contains multimedia information. Multimedia information includes text, graphics, full motion video, photographs, animation and sound. Hypermedia systems can store and retrieve such data in an inter-related fashion. Hypermedia systems are being increasingly used for providing very powerful information retrieval to support managerial decision making. In a hypermedia environment, information is relationally retrieved and presented in a multitude of media as detailed above. The user can move from one area in one media to a related item in another media. Hypermedia systems can link together many disparate pieces of information. Since information is presented in a multimedia format, it is very easy for the user to comprehend it and this makes it very interesting and user friendly and easy to understand. By allowing users to move through related items, these systems allow fast retrieval of data.

Hypermedia systems store and retrieve multimedia information in a relational manner. These systems make use of links to tie related information together. In a hypermedia system, the user can jump from one multimedia document to any related multimedia document and from subject to subject. Thus, hypermedia systems can be seen as an extension of multimedia systems. Although multimedia and hypermedia are different, they are very often used synonymously and for the purpose of this research, they were treated so.

MIS Journals

Lending and Wetherbe (1992) identified the top five MIS journals favored by the top twenty research institutions and the top five favored by other research institutions. Eight leading MIS journals were identified by Shim, English and Yoon.

A relatively new journal Information Systems Research, which was launched in early 1990 with aspirations of becoming the top journal in Information Systems, has succeeded in becoming a leading journal by attracting papers on a variety of topics. Hence this journal was added to the list of leading MIS journals. A synthesis of the leading journals identified by the above mentioned studies are listed below:

1. Communications of the ACM
2. Database
3. Decision Sciences
4. Information Systems Research
5. MIS Quarterly
6. Harvard Business Review
7. Information and Management
8. Management Science

Since this study attempts to find out the relative importance given to multimedia in recent years it will be helpful to examine other MIS journals to find out whether there is any significant difference in the importance attributed to multimedia by the leading eight journals and the others. Gillenson and Stutz (1991) found that the most highly regarded journals for IS research included those that are IS specific as well as well as computer science and management science journals. Hence, representative publications from each of these areas were selected for review. Selection of journals for the study was based on their inclusion in ABI/INFORM™, an on-line database marketed by University Microfilms Inc (UMI). A complete listing of other MIS journals that were included in this study are listed below:

1. ACM Computing Surveys
2. ACM Transactions on Computer Systems
3. ACM Transactions on Database Systems
4. ACM Transactions on Inform. Systems
5. Decision Support Systems
6. IEEE Transactions on Computers
7. IEEE Transactions on Prof. Comm.
8. IEEE Transactions on Software Eng.
9. Information Processing & Management
10. Information Systems Management
11. Interfaces
12. International Journal of Tech. Mgt
13. Journal of Information Systems Mgt
14. Journal of Information Systems
15. Journal of Systems and Software
16. Management Decisions
17. Research and Development
18. Sloan Management Review
19. Strategic Management Journal

Trade Journals

A cross section of computer and MIS trade journals available on on-line databases was identified for this research for comparison with academic journals on their coverage of multimedia related topics. The database of choice was ABI/INFORM™. A complete listing of the trade journal used in this study are listed below:

1. Computerworld
2. Data Communications
3. Datamation
4. IBM Systems Journal
5. Information Strategy
6. Infoworld
7. Journal of Systems Management
8. Management Review
9. Management Today
10. Network World
11. Networking Management
12. Software Magazine
13. Technology Review
14. Telecommunications
15. Unix Review

Review of Publications

The following sections give a brief review of the articles published in academic journals and trade journals in order to assess the number of multimedia related articles published in each of these journals.

Leading Journals in MIS

The leading journals published over the period January 1987 to December 1994 were examined to determine their coverage of multimedia related topics. The number of multimedia articles that were published was then expressed as a ratio of the total number of articles published over each time period. The ratio was chosen over the actual number to compensate for the difference in the number of articles published by the different journals.

An examination of the results shows that the journal Communications of the ACM has been the most prolific in publishing articles on multimedia in this group. 5.15% (a total of 54 articles) of all the articles published in this journal were multimedia related. The only other journals to publish on this topic were Database with 10 articles making up 1.69% of the total number of articles published and MIS Quarterly with 2 articles and Information and Management with 1 article are the only other journals to have published articles on Multimedia. To sum up, of the leading eight journals, only half have published articles on multimedia.

Other Academic Journals

A similar comparative study was made on thirteen other academic journals to find out the attention accorded to multimedia related articles. These journals were selected in a manner that all related areas of MIS were represented.

An examination of the articles published in academic journals over the period under study shows that a majority of the journals have published articles on multimedia. ACM Transactions on Information Systems gave the maximum coverage to multimedia (7.75% of all articles published). This journal was closely followed by ACM Transactions on Database Systems (5.70% of all articles published) in terms of coverage. Information Processing and Management (2.36%), Journal of Information Sciences (1.73%) and Information Systems Management (1.46%) followed these journals in the proportion of articles on multimedia that were published.

Trade Journals

A cross section of trade journals was selected for review to find out how the relative importance given to multimedia by these journals contrasted with that given by the academic journals.

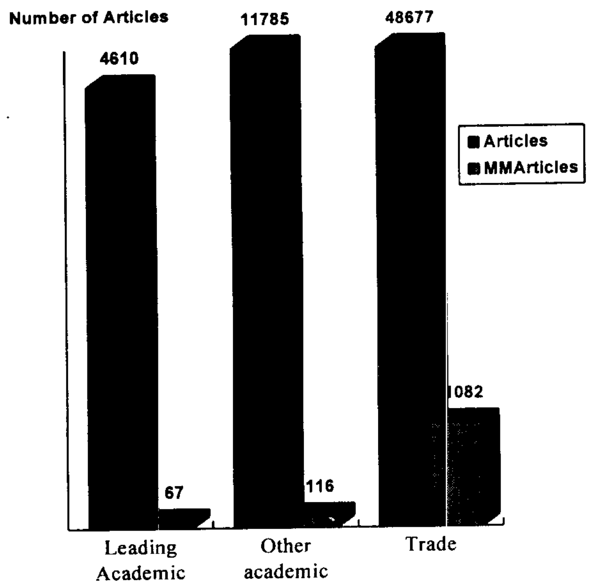
Infoworld led the trade journals in coverage of multimedia subjects. Over 4% of the articles published in this journal pertained to multimedia. Technology Review, Data Communications, and Datamation followed in the amount of coverage. The interesting fact to note here is that all the journals reviewed had carried articles on multimedia.

Discussion

During the period January 1987 - December 1994, very few articles on multimedia were published in the leading academic journals and the other academic journals. The maximum number of articles (fifty four) appeared in the Communications of the ACM. All the other leading academic journals that had published articles on multimedia published less than a fifth of this.

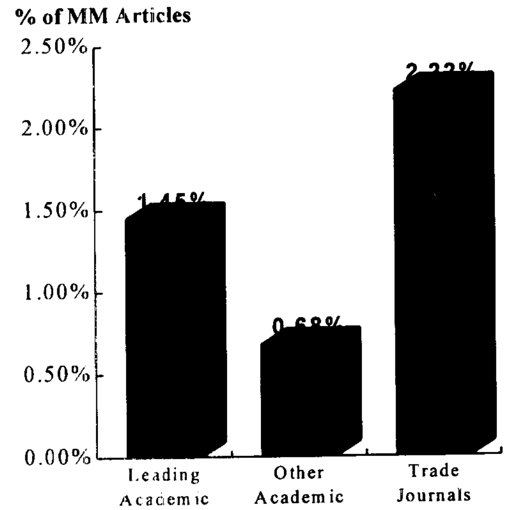
A total of sixty seven articles on multimedia have been published in the leading academic journals so thus far. The proportion of multimedia articles that appeared in the other academic journals showed the same pattern. Only a total of forty nine multimedia related articles, which made up 0.68% of all the articles published, were published during the time period under review, in these journals. Taken together, of the more than eleven thousand articles published in academic journal (leading journals as well as the others), only one hundred and sixteen articles dealt with multimedia technologies.

Contrasting these findings with the articles published in trade journals, where multimedia related articles made 2.22% of all the articles published, it is immediately apparent that trade journals have indeed been paying a much greater attention to multimedia than academic journals. In the trade journals, multimedia related articles got more than twice the coverage that they had received in the academic journals. This is clearly an indicator that multimedia concepts and technologies are receiving less attention from academic journals. Could not this be an indicator that academia is lagging the industry in this field? This study provides preliminary evidence to believe so.



Limitations

This study has some inherent limitations. Since multimedia articles that were published in the various journals were classified by the researchers, an amount of subjectivity is present. Set criteria were used for classification to keep this to a minimum. Also, the fact that academic journals typically have longer lead times for publication could explain the dearth of multimedia related articles.



Conclusions

An examination of the articles published in the leading as well as other academic journals and trade journals revealed that multimedia related articles have received greater coverage in trade journals than in practitioners journals. This could indicate that in this field academia is lagging the industry. But this finding is to be treated with caution because this could be due to effects that have not been covered in this study. The far lesser number of articles on multimedia published in the academic journals does not necessarily mean a lack of research interest in this area. But it is interesting to note the majority of academic journals have not been very prolific in publishing articles on multimedia. Is it because academia is lagging the industry? Or is it because academia sees multimedia as just another fad? The lack of published articles on this subject in the academic journals does not necessarily mean that this topic is not being researched by academia. The paradigm that theory lags practice in MIS is validated if one goes by the research published in the academic journals.

There is no doubt about the growing stature of multimedia research. A comprehensive study of the effect of multimedia on organizations, businesses and education is needed to assess the importance of multimedia in today's world. There is a need for research along these lines to prove or disprove the importance accorded to multimedia.

A full copy of the original paper, including references, is available from:

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Is There A Culture Gap Between MIS and Their Clients?

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ABSTRACT

The culture of a company is based on the organizational values set by and perceived by others within the firm, organization, institution, or department. The values of an organization are the entities that set one organization apart from others. Different values yield a unique culture. Value systems within an organization are under constant change from both internal and external forces.

Many of these forces are causing value changes within MIS departments. At one time, MIS departments were able to impose its solutions on end users with little or no input from end user management. Now the focus is on jointly developing MIS systems. In order for successful joint projects to be developed, both MIS and end user departments must have an understanding of their respective organizational values. This paper reports the results of a survey on organizational values as they pertain to MIS projects.

INTRODUCTION

A somewhat popular belief of personnel outside the MIS department is that "IS adhered to its own rules, forced compliance to its own procedures, addressed users in its own lingo, and had control over its resources ... "[4] when developing systems projects. But the changing forces of downsizing and technology advances have permitted end users and clients of MIS departments to wrest partial control away from MIS and their former position of dominance in systems design work. More strategic use of computers by management also influences the changing environment.

Today, the work environment is more of a cooperative venture between clients and MIS. In fact, "IS must define its role in each problem solving situation by taking into account the needs, values, and capabilities of the user". [4] To ignore the client imperils the success of the project. In the past, it was common to notice personality conflicts and problem situations arising from differences of opinion between clients and MIS. "Friction between business users and systems developers is apparent in many organizations". [9] Vested interests were often more important than the success of a particular project.

Not only are vested interests a problem, but "Communication barriers have evolved between communities to retain and protect their cultures". [9] Different senses of value impede systems projects. When clients and MIS personnel attempt to protect their own culture over the good of the organization, more serious problems arise. "Cultural barriers hinder effective business practice and incur costs to the organization". [9]

The role of management in handling these situations, where different interests arise, is important. Projects must be managed "... end-to-end, encompassing users, information systems, and applications ..." [7] in order to produce the most viable, cohesive product. Where end users and their idiosyncrasies have been partially ignored or denigrated "Executives have seen domestic implementations of IS fail because the approach did not address the user's particular circumstances, needs, and mindset". [2] To rectify this problem, corporate controls extraneous to the project are often imposed to insure the results of joint efforts between end users and MIS. External controls provide both a bond and a sense of corporate influence over any given project. "Controls are organizational constraints designed to secure compliance with established company policies ...". [5] Their use is sometimes necessary to reduce the effect that different cultures can have on joint projects between end users and MIS. In fact, the view may be that "Control is necessary in an information driven organization." [5]

When the client and MIS personnel are in the early stages of project development, other conflicts arise because the client may desire the project to be completed swiftly at any cost. MIS may not want to incur overtime costs to meet target dates requested by clients. Clients may want the latest hardware installed while MIS may want to utilize excess capacity available with the present hardware. In these cases, it is obvious that "There are inherent conflicts between some attributes ... Trade-offs must be made to enhance any given value element." [6] in the project. These trade-offs are even more significant as a factor when considering the changes that new technology have on organizations. Benjamin [1] and Foster and Flynn [3] "provide ... arguments regarding the impact of ever improving technologies on organizational forms and functions" .[8]

MIS departments must be aware of all the changing factors and take them into consideration in all joint ventures. In a value based management system, the values of the organization and the individual are in harmony, providing a common focus point for all involved. Does that situation exist in MIS departments today?

Figure 1
Nine Pre-defined Values for Comparison

Value Category
Accuracy
Adherence to standards
Completeness of output
Completion time
Ease of use
Expectations Met and Relevance
Implementation cost
Operation and Maintenance cost

METHODOLOGY

The focus of this paper is on organizational values as they relate to end users (clients) and MIS personnel. What values are important to the individuals in these two groups? To answer this question, a survey was prepared. The questionnaire asked individuals to assess values using a paired comparison instrument. The instrument defined nine categories. The nine values are shown alphabetically in Figure 1.

On the questionnaire, each of the nine values was paired eight times — once with each of the other eight values. Each respondent was asked to compare the set of two values and choose their preferred value in each pair.

Nine hundred copies of the survey were distributed to firms and individuals. One mailing

Table 1
Current Position in Firm

Position	Number of Respondents	Per Cent
End (Client) User	22	15.8
End (Client) Management	24	17.3
MIS Staff	51	36.7
MIS Management	42	30.2
Totals	139	100.0

was sent to 300 members of three local area MIS groups. Two copies of the questionnaire were enclosed in these mailings, with a request to the MIS contact person to distribute the second copy to their client counterpart in the organization. Another group of surveys were distributed to the personnel directors of 300 regional manufacturing firms. A total of 139 surveys were returned, a response rate of 15.4%.

The respondents are identified by job position in Table 1. Notice that two-thirds of the respondents are either MIS staff personnel or MIS management. The lowest number of returns came from end users, which is likely the group most affected by the culture and the policies of the MIS department and the ones who should provide significant input.

The second question on the survey helped identify the company size at the current location. As indicated in Table 2, nearly one-third of the respondents work at small firms or plants (100 employees or less). The second largest group work at locations with 1500 to 5000 employees. The third question asked the respondent to identify their primary computing tool.

Over 50% of the respondents now use a PC in a networked environment as their primary computing device. However, only a few — 5%, employ a dedicated PC as the primary computing device. A surprising number, nearly 45%, still use a terminal connected to either a minicomputer or a mainframe computer to complete their work.

Table 2
Company Size at Current Location

Category	Number of Respondents	Per Cent
0 - 100 Employees	45	32.4
101 - 250 Employees	20	14.4
251 - 500 Employees	13	9.4
501 - 1500 Employees	21	15.1
1501- 5000 Employees	38	27.3
Over 5000 Employees	2	1.4
Totals	139	100.0

Table 3
Primary Computing Tool

Category	Number of Respondents	Per Cent
Desktop/ Standalone Computer	7	5.0
Networked PC	70	50.4
Minicomputer	28	20.1
Mainframe	34	24.5
Totals	139	100.0

Added comments by a significant number of respondents (12) indicated that they used *both* a networked PC and a terminal connected to either a minicomputer or a mainframe. If this choice had been added to the possible list of choices, the questionnaire may have yielded different results than those displayed in Table 3.

The results of the paired comparison instrument are discussed next. For each questionnaire received, several counts were computed. The first count on each questionnaire summed the number of times each of the nine factors was selected as having the most value in an MIS project compared to each of the other eight factors. The second count identified which of the nine value factors in an MIS project was selected most often by each respondent.

Table 4 shows the culture value chosen most often by the clients (end users and end user management combined). The counts are ranked in order by the value chosen most frequently. The ranking indicates that the clients are overwhelmingly concerned with *accuracy*. Over half (56.5%) of the client respondents chose accuracy more often than any other factor. With regard to MIS projects, it is clear that the client culture dictates

Table 4
Value Chosen Most Often by Client End Users and Client Management

Value Category	Number of Respondents	Per Cent
Accuracy	26	56.5
Expectations Met/Relevance	6	13.0
Ease of use	5	10.8
Reliability/Response time	3	6.5
Completeness of output	3	6.5
Completion time	2	4.3
Implementation cost	1	2.2
Adherence to standards	1	2.2
Operation/Maintenance cost	0	0.0
Totals	46	100.0

accuracy as the key criteria. No other value is mentioned frequently.

At the opposite end of the ranking, even though management in many organizations stress *adherence to standards* and adherence to company or department policies, only one of the respondents chose it most frequently. And while cost management is cited often in industry literature, only one respondent selected *implementation cost* as the most important value. What might be more surprising is that not one client user or client manager chose *operational and maintenance cost* as the most important value factor. Upper management might be both surprised and concerned with this response.

Table 5
Value Chosen Most Often by MIS Staff and MIS Management

Category	Number of Respondents	Per Cent
Accuracy	55	59.1
Expectations Met/Relevance	17	18.3
Completeness of output	7	7.5
Reliability/Response time	7	7.5
Ease of use	5	5.4
Adherence to standards	2	2.2
Implementation cost	0	0.0
Completion time	0	0.0
Operation/Maintenance cost	0	0.0
Totals	93	100.0

Table 5 shows the culture value chosen most often by the MIS personnel (staff and management combined). Once again, the counts are ranked in order by the value chosen most frequently. The ranking indicates that MIS personnel are also concerned primarily with *accuracy*. An even higher percentage (59.1%) of the MIS respondents chose accuracy over other factors. This percentage correlates highly with the client responses, indicating that there should be little or no culture disagreement over this factor in MIS projects.

Whereas the clients had no clear cut second choice in terms of values, nearly one-fifth (18.3%) of the MIS respondents are concerned with user *expectations and the relevance* of the project. From a management and client viewpoint, this number must be construed as a positive indicator, suggesting that MIS is aware of the concerns of the client and the viability of the project.

Consistent with the client rankings, a minimal number (two) of MIS respondents chose *adherence to standards* as the most important culture value. Likewise, cost management is not a concern to the MIS group, either. Not one respondent cited either *implementation cost* or *operational and maintenance cost* as the most important value factor. Also note that the value *completion time* was not chosen as most important on a single survey even though project backlogs are the subject of frequent discussions by client managers and MIS managers.

The next two tables show pooled responses. A third count was derived from the surveys by determining if a particular culture value was one of the top three choices by a respondent. Table 6

Table 6 - Pooled Responses
Value Chosen As One of the Top Three by Client End Users and Client Management

Category	Number of Respondents	Per Cent
Accuracy	37	26.8
Completeness of output	32	23.2
Expectations Met/Relevance	24	17.4
Reliability/Response time	22	15.9
Ease of use	8	5.8
Completion time	6	4.3
Adherence to standards	5	3.6
Implementation cost	2	1.5
Operation/Maintenance cost	2	1.5
Totals	138	100.0

reflects the pooled choices for the clients (end users and management combined).

As in Table 4, *accuracy* appeared most often. Out of a total of 46 respondents, 37 or 80.4% cited accuracy as one of their top three choices. Pooling the top three choices in Table 6 also identifies three other factors important to the clients: *completeness of output*, *expectations met and relevance* of the project, and *reliability and response time.*

Table 7- Pooled Responses
Value Chosen As One of the Top Three by MIS Staff and MIS Management

Category	Number of Respondents	Per Cent
Accuracy	82	29.4
Expectations Met/Relevance	58	20.8
Completeness of output	57	20.4
Reliability/Response time	46	16.5
Ease of use	19	6.8
Adherence to standards	7	2.5
Completion time	5	1.8
Implementation cost	3	1.1
Operation/Maintenance cost	2	.7
Totals	279	100.0

Nearly as many clients (32 or 69.6% of the total client surveys) listed *completeness of output* as one of their top choices. Two other values, *expectations met and relevance* of the project plus *reliability and response time* appeared a significant number of times.

Also consistent with Table 4 were the choices at the bottom of the ranking: *completion time, adherence to standards, implementation cost* and *operational and maintenance cost.* These values are simply not important compared to the other issues facing the clients.

Table 7 lists the pooled responses for the MIS personnel (staff and management combined). Again, the counts are ranked in order by the values that appear as one of the top three choices by the MIS respondents.

As expected, *accuracy* appeared most often. Out of a total of 93 surveys, 82 or 88.2% of the MIS personnel selected accuracy as one of the top three choices. Consistent with Table 5 and the client responses shown in Table 6, the next three values selected among the top three factors are: *expectations met and relevance* of the project, *completeness of output,* and *reliability and response time.*

Also consistent with Tables 5 and 6 are the choices at the bottom of the ranking: *adherence to standards, completion time, implementation cost* and *operational and maintenance cost.* As noted earlier, neither clients nor MIS personnel place much value on these issues.

CONCLUSIONS

The survey shows that both groups have similar priority values. Both gave *accuracy* the highest priority. To a secondary degree, both groups gave the three values: *expectations met and relevance* of the project, *completeness of output,* and *reliability and response time* some measure of importance. Also consistent in the two groups are the low rankings of *adherence to standards*, *completion time*, *implementation cost* and *operational and maintenance cost*.

With many articles in the literature detailing the advantages of GUI and click-and-point processing, a surprisingly low value was given to *ease of use* by both groups (clients and MIS). It was situated in the middle of the rankings in all of the tables.

Given the homogeneity of the responses, contrary to the references cited earlier and contrary to much of the research published, there is no indication from this research that differences in culture values exist for clients and MIS personnel. In fact, both groups agree on what is important to them and also agree on what is of little importance to them.

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PROFESSIONAL CERTIFICATION IN THE INFORMATION SYSTEMS FIELD: A MODEL FOR INTEGRATION WITH FOUR-YEAR ACADEMIC PROGRAMS

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ABSTRACT

This paper discusses professional certifications available from the Institute for Certification of Computer Professionals, Novell, and Microsoft. The requirements for the certifications are explained along with possible advantages that accrue as a result of certification. The paper discusses the issue of what four-year colleges should do to address the apparent industry need for certifications. A curriculum model is suggested which would allow students to gain both a foundation in broad conceptual areas and the specific expertise necessary to become effective information system professionals.

INTRODUCTION

The purpose of this paper is to provide an overview of several major certifications available, their importance in the IS (information systems) field, and their potential impact on four-year academic IS programs. For the purposes of this discussion the certification will be divided into two categories:

Category 1: Broad, generic, concepts-oriented certifications from the ICCP (Institute for Certification of Computer Professionals)

Category 2: Technical/proprietary (vendor specific) certifications such as the CNE (Certified Netware Engineer) from Novell and the MCSE (Microsoft Certified Systems Engineer) from Microsoft

For each category the discussion will include a background description with strengths and weaknesses of the programs, numbers of certified individuals, and to whom such a certification might be most valuable.

LITERATURE REVIEW

As recently as 1988 professional certification for IS personnel was not viewed as particularly important in employee selection (Mingus). Certainly IS certification has never enjoyed the distinction that the CPA and CMA designations receive in the accounting world -- partly due to the absence of clearly established, universal, definable knowledge and skills (Mingus). One recent study (Mawhinney, Morrell and Morris) shows that employers still do not rate the ICCP certifications highly in terms of qualifications for new hires in the field. Recently, however, there have been significant increases in the numbers of individuals seeking various kinds of certifications (Cocks). Still, some certifications are criticized as misleading and providing a false sense of security (Hertz).

Conflicts between testable concepts that do not favor knowledge of IBM, MacIntosh, Unix, or particular software packages versus specific knowledge and skills that truly make the professional able to do the job are reflected in the two major types of certifications, just as they are reflected in the ongoing curriculum debates within higher education (Foster, Larman). "There appears to be little middle ground between narrow, product-focused testing and certification programs offered by vendors and the broad, general format of the ICCP" (Moad).

The ICCP certifications have been most popular among IS professionals who do not have IS academic credentials, whether coming to the IS field from another area (often mathematics, engineering, or accounting) or lacking any academic credentials. Particularly in higher education the ICCP certifications have been utilized to validate the expertise of IS faculty with Ph.D.s in other areas (Duncan). They have also been used as a measure of professional/career commitment and as a force for continuing education (Mingus). ICCP certification requires subscribing to a "Code of Ethics" which is thought to make ICCP certification a "statement for self-regulation in the industry" (Little).

Some concern has been expressed about whether a mainframe-oriented organization like ICCP can keep tests as relevant as necessary in a fast changing area (Foster). "ICCP's lack of emphasis on emerging technologies has led some IS managers and training experts to look elsewhere for testing and certification" (Moad).

Recently, however, the ICCP has at least partially addressed some of these concerns by accepting the CNE certification in lieu of one "specialty" exam in the new CCP certification program (ICCP Newsletter).

Certification can be of value to many individuals and to the organizations employing them. Particularly in the microcomputer environment many people have learned "by doing" and they need some way to document their expertise (Foster). Certification enhances other credentials (degrees) to make the holder appear more professional (Bredin, March 1992). Certification may also provide an edge needed by minorities to get past some discriminatory hiring and promotion practices (Bredin, October, 1992).

Because of a continual flow of new, complex products, the technical/proprietary certifications provide some standards for the development of functional levels of expertise. On the negative side, the motivation of certification providers and test constructors (to legitimize a particular area, sell a product, etc.) may compromise the value of some proprietary certifications (Larman). Additional criticisms of proprietary certification programs often relate to a lack of application of knowledge -- correct answers require memorization rather than understanding, depend on phrasing rather than functionality, and may give excessive weight to rarely used esoteric features. (Marks, 1994).

The need for real experience is not well addressed by current certification programs in the IS field when compared to fields like medicine, law, pharmacy, and accounting (Danielle). Furthermore, there are contradictions between survey results that stress the importance of broadly-based concepts and problem solving skills for IS professionals and the actual hiring practices that specify CNE or other technical certifications (Cocks).

CERTIFICATION PROGRAMS AVAILABLE

Category 1: the broad, generic, concepts-oriented ICCP certifications:

The ICCP (Institute for Certification of Computer Professionals) certifications are broadly based and deal with concepts and general IS knowledge rather than product- or platform-specific skills or issues. The ICCP was founded in 1973 by the Association for Computing Machinery (ACM) and the Data Processing Management Association (DPMA) for the purpose of certifying the background and expertise of individuals in the IS field before the existence of many college or university programs in the field. ICCP certifications are now supported and recognized by more than a dozen professional organizations in the IS field.

Although the ICCP has recently gone to a single designator (CCP for Certified Computer Professional) there were previously several different certification programs including the CDP (Certified Data Processor), the CSP (Certified Systems Professional), CCP (Certified Computer Programmer), and ACP (Associate Computer Professional). Each certificate had a somewhat different focus (systems management, systems development, programming, etc.), but all were broadly based in content and concepts, and with the exception of the ACP, required several years of workplace experience in addition to the passing of a series of exams. Approximately 50,000 individuals hold ICCP certification (ICCP Newsletter).

Any ICCP certifications earned since 1986 require a recertification process which involves 120 hours of approved educational activities over a 3-year period. The new, single designation CCP (Certified Computer Professional) requires passing a broadly based "core" exam, two "specialty" exams (e.g., business information systems, communications, data resource management, management, office information systems, software engineering, systems development, systems security), four years of professional experience, and adherence to the code of ethics. Two programming language exams may be substituted for one specialty exam.

Whereas ICCP standards could readily be used as a "yardstick" against which academic programs could be measured, they never really posed any competition for academic programs -- tending to follow the directions of academe rather than charting new ground. About the only relevance to four-year academic programs might have been to provide a good "exit" testing opportunity or to validate the degrees earned from lesser-known institutions.

Category 2: Technical/Proprietary Certifications

Several certification programs are offered by vendors dealing with their specific products. The Novell and Microsoft certifications are the most significant of these.

NOVELL CERTIFICATION PROGRAMS

Novell provides four different certifica-tions: 1) Certified Netware Administrator (CNA); 2) Certified Netware Engineer (CNE); 3) Enterprise Certified Netware Engineer (ECNE); and 4) Certified Netware Instructor (CNI). The discussion below will focus mainly on the CNE and ECNE. These certifications require passing a series of proficiency tests to demonstrate mastery of networking concepts.

Novell's CNA certifies people to be capable of administering a local area network (LAN). Individuals need pass only the first administration test for the operating system of their choice, e.g., Netware 3.1x Administration.

Novell's CNE requires students to earn a total of 19 credits. These CNE proficiency tests are divided into four categories: 1) prerequisite courses; 2) operating system course; 3) core courses; and 4) elective courses. The prerequisite course is a choice between DOS (and microcomputer concepts) and UNIX. There are three paths for the operating system courses: 1) Netware 4.0; 2) Netware 3.1x; and 3) UnixWare. The two core courses are Networking Technologies (3 credits) and Netware Service and Support (5 credits). An elective course of two or more credits completes the requirements. CNEs must also meet continuing certification requirements. About 10,000 individuals hold CNE certification, and there are approximately 50,000 certifications in progress.

Novell's ECNE program consists of 19 credits and demonstrates a level of networking knowledge above that of a CNE. ECNEs have proficiency in both Netware 3.1x and Netware 4.0 operating systems. Some CNE courses will also fulfill ECNE requirements. Depending on the operating system path and electives taken by the CNE, an additional 7 - 12 credits are needed for the ECNE.

The CNI program certifies individuals to teach Novell courses for which they are certified at Novell authorized facilities. Students must attend each course they want to teach at an Novell Accredited Education Center, Novell Accredited Education Program, Novell Technology Institute, or authorized international site. A CNI test for the target course(s) must be passed, along with an Instructor Performance Evaluation (IPE). The latter ensures that a CNI's instructional skills and levels of technical knowledge meet Novell's standards.

MICROSOFT CERTIFICATION

Microsoft contends that its Certified Professional program helps professionals assess and promote their skills, provides valuable technical information, and contributes to greater success for the certified individual. As organizations invest in new technologies they are looking for technical professionals with expertise in specific products to help build and implement applications. The certification achievement stands for technical savvy, innovation, and quality. Three certifications are available from the Microsoft Certified Professional program:

Microsoft Certified System Engineers become qualified to implement, maintain, and support information systems with Windows NT and other advanced systems and workgroup products. There are currently about 1,000 MCSEs and approximately 20,000 certifications in progress (Microsoft Education and Certification Roadmap).

Systems Engineers must pass four operating system exams (chosen from Microsoft Windows 3.1, NT 3.1, Advanced Server 3.1, Networking with Windows 3.1 or Networking with Windows 3.11) and two elective exams (chosen from Microsoft SQL Server 4.2 Database Administration for OS/2 or Windows NT 3.1, Microsoft Mail for PC Networks 3.2, Microsoft LAN Manager 2.1 Network Administration, Microsoft LAN Manager 2,1 Advanced Network Administration, Microsoft SQL Server 4.2 Database Implementation).

Microsoft Certified Product Specialists are qualified to install, customize, and support Microsoft's desktop products. Product Specialists must pass one operating system exam (Windows 3.1 or Windows NT 3.1) and one elective exam (Chosen from Word for Windows 2.0, Microsoft Excel 4.0, Project 3.0, Mail for PC Networks 3.2 - Desktop exam).

Microsoft exams are developed with the input of professionals in the industry, and they reflect how Microsoft products are used in actual organizations (Microsoft Education and Certification Roadmap). The necessary background can be obtained from instructor-led classes taught by Microsoft Certified Trainers at one of their Authorized Technical Education Centers, or from self-study courses which are available in video, workbooks, or computer-based training formats.

Microsoft Certified Trainers are able to teach Microsoft courses at a Microsoft Solution Provider Authorized Technical Education Center. Only trainers employed by or under contract to Microsoft Solution Provider Authorized Technical Education Centers can become Microsoft Certified Trainers. Trainers are certified on a course-by-course basis. They must attend trainer-preparation courses and pass professional exams.

To maintain Microsoft Certified Professional status certified individuals must remain current on all the requirements for the certification. If the new requirements are not completed within six months, the individual will be decertified. decertification.

DISCUSSION AND CONCLUSIONS

A key question when discussing certification is "Who needs it?". When considering the descriptions of category 1 and 2 certifications, it is evident that they are tailored to two different markets. Category 1 certifications are ideal for people who need validation of their expertise, e.g. people who have learned by doing and do not have a formal degree.

Category 2 certifications are particularly valuable to two groups: 1) mainframe gurus who need to be rethreaded in some of the newer technologies, e.g., as networking, client-server architecture, etc.; and 2) degree students who are looking for their first full-time job in the field and who need expertise in one area, e.g. a specific network operating system. Employers indicate that they want students to know concepts (be generalists), yet when hiring they will choose the person with the required expertise (a specialist). Certifications can help students gain employment in this competitive field by ensuring expertise in an area. Some employers even ask for a specific certification. Also the feeling among many academics is that industry really wants multi-specialists, not just a specialist. Certifications in various products would be an ideal way to meet this need.

In addition to the markets addressed by the two categories of certification, the whole issue of certification fits right into the dilemma four-year institutions have struggled with for years: should students be taught concepts or skills, or some mixture of the two?

Academic institutions have many strengths to bring to the arena: skilled teachers with years of experience, a curriculum that covers Information Systems concepts very well, and a time frame (semester or quarter) that allows time for the information to sink in. Contrast this with today's training centers that offer 3-day crash courses where students are overwhelmed with information. The instructors in the training centers, while being experts in their fields, are often poor teachers.

One approach is simply to say that certification programs address different goals and needs than do four-year IS programs; therefore, there is no need to consider the demand for them or to compete with them. That approach could be very shortsighted indeed. If the popularity of certification programs reflects changing needs for educational services, IS faculty should know about them, evaluate the four-year programs relative to these changing needs, and position the programs to meet a greater portion of these needs. The alternative may be to wake up someday soon and see the four-year programs as dinosaurs in the IS world.

A middle ground is proposed to bridge the traditional four-year program coursework and the product-specific certification programs. The model outlined below is based on the premise that the demand for certification programs cannot be ignored. It advocates an integration of degree programs with certifications and capitalizes on the teaching skills, resources and breadth of technical background already in place in the four-year institutions.

MODEL FOR THE INTEGRATION OF FOUR-YEAR DEGREE PROGRAMS AND CERTIFICATIONS

The proposed model assumes a core of required Information Systems courses as follows:

- Structured Programming
- Programming Language (Procedural or Non-Procedural)
- Systems Analysis and Design
- Database Design and Implementation
- Microcomputer Platforms
- Telecommunications.

Assume that a student is interested in pursuing Novell certification. The aforementioned required courses act as a solid foundation for further learning. To improve knowledge of the networking field, the student can take a Local Area Network and Wide Area Network (LAN/WAN) course from a list of electives. Then the student can take a semester-long course in NetWare Certification. This course could cover the administration, advanced administration and installation/configuration for a particular operating system, for example 3.1x. This particular student could now be prepared to take five CNE tests, namely:

- DOS/Microcomputer Concepts [Microcomputer Platforms]
- Networking Technologies [Telecommunications and LAN/WAN]
- NetWare 3.12 Administration
- NetWare 3.12 Advanced Administration.
- NetWare3.12 Installation/Configuration

Further CNE-type courses could be offered to allow the student to cover all the material for the complete CNE. The department would have to decide how many of these CNE certification courses would be accepted as electives.

The above model could be used for any certification. If a student wants Microsoft Certified Systems Engineer certification, the required courses could be followed by the LAN/WAN course and then a Windows NT certification course offered as an elective. How many certifications a department will support depends on resources. It is likely that the most popular certifications (currently Novell and Microsoft) could be offered in this approach.

This model provides the student with the solid foundation of a four-year degree and expertise in Novell or Microsoft product specifics. The combination should produce a stronger job candidate than either the traditional degree or certification alone would produce. Using this model or another similar curriculum model also serves as a way for four-year colleges to address industry's need for expertise in specific software programs by their future employees.

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An Information Scanning Approach for Learning to Work on the Internet

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ABSTRACT

Access to global information fundamentally alters the information scanning function of decision makers. The flattening of the management pyramid means information scanning of external sources is being performed by personnel in middle and lower levels of management, not only in the traditional "senior" level of managers. Both graduate and undergraduate classes in information systems can effectively address the use of external information scanning through the teaching of Internet skills. This paper presents the course outline for a class in Global Communication Networks where a project-oriented approach was used to teach Internet skills. The importance of global information systems in decision making and the use of the Internet as an information resource was emphasized in this class. A survey of students in the class found that this approach was successful in improving the perceived value of Internet-related tools for information scanning and professional decision making.

INTRODUCTION

Global communication networks have changed the way that people communicate. International access to people, data, software, documents and multimedia has resulted in new methods for scanning for information, processing personal and business communications, and, ultimately, solving business problems. The Internet has emerged as the principle global communication network for academics and is rapidly approaching that status with industry. Recently it has been estimated that the Internet consists of over 1.5 million host computers attached to more than 13,000 separate networks in more than 125 countries [1]. Some experts are predicting that the Internet will connect over a hundred million users in the near future [2]. Currently the United States in engaged in a national debate on the Information Superhighway in regard to such issues as universal availability, computer security, appropriate communication standards and the role of government regulations [3].

As information systems educators, it is vital that we teach our students an appreciation for global communication networks and their impact on business communications. The role of these networks in corporate decision making and strategic planning should be emphasized. In addition, there has been an increasing emphasis on internationalizing the information systems curriculum. Interestingly, Deans [4] and Deans, Loch and Roche [5] do not mention the Internet as a means of internationalizing the information system curriculum. However, both Fielder [6] and Ellsworth [7] describe class projects that involve international collaboration on the Internet. Whinston [8] views the Internet as a tool for fundamentally altering the university curriculum by allowing a greater diversity of subject content, by enhancing collaborative educational experiences, and by permitting greater customization of course content.

While many books have been written that teach Internet skills (see [9] and [10]), few papers have been written on the best methods for teaching these skills. Two exceptions are [6] and [11]. In order to aid students in obtaining the experiences and intellectual mastery necessary to appreciate the impact of global communication networks, Fiedler [6] presents a modular approach to teaching the Internet that motivates students by increasing their interest in the subject while building their confidence in computer skills. Ellsworth [7] suggests a "learning project" as a good way for students to gain Internet skills, yet provides no empirical evidence as to the effectiveness of this approach.

INFORMATION SCANNING AND DECISION MAKING

Computer-based information systems have long played an important role in corporate decision making. Turban [12] identifies a four step decision-making process (problem identification, analysis, choice and implementation) and describes how various information technologies support decision-making. Turban and Meredith [13] make a compelling argument that managers must become more sophisticated in their use of information technology in the decision-making process due to increasing technology, information, complexity, competition and internationalism. Watson [14] conducted a survey of the information scanning habits of 43 Australian IS managers and found that IS managers should consider broadening their scanning if they wish to find new opportunities for exploiting information systems technology.
Traditionally, information external to the firm has been viewed as primarily an asset of "senior" executives. It was felt that only senior executives involved in strategic planning would need information on competitors, industry data, and international economic trends. In traditional hierarchical management there was little idea that direct contact with customers or an infusion of complex external information sources would benefit the organization. However, global communication networks have made external data available to all levels of management. According to Drucker [15], the most important source of information for competitive advantage and strategic decision making comes not from internal data but from external sources. Cronin [16] has documented over twenty case studies where organizations have effectively used "networked information from the bottom-up" to their benefit.

The shift from a traditional hierarchical model of the firm to a networked enterprise suggests an information scanning approach to teaching students about global communication networks. In particular, it was felt that a course that emphasized the role of information systems in the decision making process would motivate students to learn more about the Internet and would also serve as a tool to help those students solve problems. In addition this meant that an information resource perspective of the Internet would be used rather than a technology perspective. One of the Internet's attributes is its ability to provide immediate global access to information. Thus the five categories of information resources available on the Internet (people, data, software, documents, and multimedia) were stressed over the various technologies needed to access those resources (i.e., ftp, telnet, gopher and World Wide Web).

COURSE OUTLINE

A course in Global Communications Networks was designed as a one credit hour short course in the Masters of Business Administration program. The purpose of the course was to introduce the student to international inter-organizational computer networks and their impact on business communications. In particular, the role of global networks in information scanning and organizational problem-solving were stressed. In addition, the Clinton administration's proposed "National Information Superhighway" was discussed. A major portion of the course included hands-on usage of the Internet. The course was an optional elective that was taught in only five three-hour evening class segments. In addition, over half of the students in the class had not yet had a formal course in Management Information Systems. As a result of the tight time frame allowed in the class and due to possible fears students might have in learning about a new technology within such a time frame, much thought was given to the design of the class.

Interactive Internet skills were stressed in the first three class sessions. In the first session electronic communications was taught through the use of on-campus electronic mail, Internet electronic mail, and LISTSERV's. The first assignment emphasized using these skills to identify their research project. In the second class session, remote login (Telnet), file transfer (FTP) and menu-based interfaces for Internet databases and tools (Gopher) was taught. A second assignment started the student's Internet search for relevant data sources. In the third session, Internet search tools (archie, Veronica and WAIS) and hyper-text based documents (World Wide Web) were taught. At this point, the students were asked to present an outline of their final report and to present a "search strategy" for finding additional information for the class project.

In order to assess students on the Internet skills they had learned, each student submitted a research paper that included information accessed through the Internet. It was intended that the research paper support ongoing project work that the students were conducting at work, in research activities or in other classes. Each report had a section on "How the Internet was Used to Obtain Information Resources". It was suggested that the author not take on a problem with too wide a scope. An outstanding paper presented a clear, concise, well-written and well-referenced document that thoroughly covers the issue at-hand. Many of the students were concurrently enrolled in a class in International Finance. As a result, students were quite successful in accessing international economic data and forecasts on such countries as New Zealand, Indonesia and Guatemala over the Internet. Other papers focused on such topics as "The Impact of the Internet on International Marketing" and "The Role of Global Communications in the Aircraft Manufacturing Industry". It should be noted that the class projects involved at least one face-to-face meeting between the professor and the student to reach agreement on project scope and to determine appropriate Internet search strategies.

One interesting topic that emerged from this class was a project that described how one should properly reference information sources found on the Internet. Different sources of information on the Internet must be carefully examined for accuracy and recency before attempting to properly reference the information source. The result of this project was a paper entitled "Data Integrity and the Internet: Implications for Management" [17]. Appropriate methods for referencing electronic information can be found in Li and Crane [18] and Dodd [19].

COURSE ASSESSMENT

As discussed before, the two-fold theme of the course in Global Communications Networks was:

a) the importance of information systems for decision making, and
b) the use the Internet as a information resource for class reports.

A mechanism was needed to assess the effectiveness of this approach in teaching Internet skills. As a result, two surveys were administered to the class. An initial survey, administered at the beginning of the first class session, assessed the work experience, computer experience and the importance of various information sources in the respondent's professional decision making and problem solving. Fifteen students, with an average of 3.9 years of work experience, responded to the survey. A wide variety of computer skills and professional positions were reported. Only four respondents had used FTP, telnet, or the Internet before enrolling in the class. Each respondent indicated the importance of the different information sources on a seven-point scale with 7 indicating that the information source was extremely important for decision making and a 1 indicating that the information source was not at all important in decision making. The results of this survey are shown in Table I.

A follow-up survey was administered at the conclusion of the final class. It again asked the students for the importance of various information sources in professional decision making. In addition, it asked each respondent three questions: (1) What changes would you like to see take place on the Internet in order to improve its usefulness for business decision making?, (2) Comment on the value of information technology/information systems on the MBA curriculum, and (3) Comment on the value of course material of global communication networks in the MBA curriculum. Finally, traditional university administered student evaluations were used to assess the effectiveness of the class.

As examination of Table I indicates that the largest positive changes in average score were for the Wall Street Journal, National Newspapers, Internal E-mail, External E-mail, and Electronic Journals/Documents. This is a good indication that the value of electronic sources of information (Internal E-mail, External E-mail, and Electronic Journals/Documents) was perceived to be of higher value for decision making at the conclusion of the class. The open-ended questions on the survey indicated that there was some frustration on the part of the students with using the Internet. One student indicated that the Internet would be more useful for business decision-making if there was more standardization of user interfaces, quicker response from heavily used sites, and better ways to filter important information from the "idle chit-chat".

The open-ended questions on the follow-up survey also gave some insight into the value of the Global Communications Networks class in relationship to the overall MBA program and the current MIS class in the MBA program. A typical response was that "the Internet should be a valuable resource for later MBA coursework" and that "it should be offered early in the MBA curriculum". An unexpected, but beneficial, result of the class was the realization on the part of many students on how technology will influence their jobs and their careers. One student summarized this by saying "knowledge of information technology and the ability to interpret that information gives future MBA's a leading edge in the marketplace."

Source of Information	Initial Survey (Avg. Score)	Initial Survey (Std. Deviation)	Follow-Up Survey (Avg. Score)	Follow-Up Survey (Std. Deviation)	Change of Avg. Score
Wall Street Journal	3.58	1.98	5.08	1.75	+1.50
National Newspaper	2.58	1.80	3.83	1.67	+1.25
Regional Newspaper	3.09	2.07	3.83	1.67	+0.74
Local Newspaper	3.58	2.02	3.45	1.78	-0.13
Harvard Business Review	2.73	1.86	3.27	1.81	+0.55
Business Week	3.08	1.66	3.55	1.56	+0.46
Academic Journals	3.15	1.99	3.18	1.80	+0.03
Industry Magazines	4.92	1.73	4.36	1.43	-0.56
Trade Shows	4.15	2.14	3.73	1.60	-0.43
Trade Journals	4.15	1.99	4.55	1.56	+0.39
Professional Books	4.93	1.79	4.42	0.95	-0.51
Conferences	4.08	1.73	4.25	1.83	+0.17

Table I: Results of Information Scanning Surveys. Each "Source of Information" was ranked on a seven-point scale that indicated the importance of these sources in professional decision making and problem solving. (Scale: 7 - extremely important, ..., 1 - not at all important) Note: changes in ranking may appear inaccurate at the .01 decimal place due to rounding of reported results.

Source of Information	Initial Survey (Avg. Score)	Initial Survey (Std. Deviation)	Follow-Up Survey (Avg. Score)	Follow-Up Survey (Std. Deviation)	Change of Avg. Score
Face-to-Face Communication	6.27	0.93	6.00	1.24	-0.27
Telephone Conversation	6.14	0.99	6.00	0.96	-0.14
E-mail (external to the firm)	4.58	2.33	5.42	1.26	+0.83
E-mail (internal to the firm)	4.18	2.25	5.42	1.26	+1.23
Documents and Journals in Electronic Format	4.00	2.12	4.83	1.40	+0.83
Common Interest Groups (Computer)	3.40	2.20	3.77	1.42	+0.37
Seminars and Courses at University	4.29	2.43	4.15	1.79	-0.13
Visiting another Organization	4.42	1.50	4.23	1.89	-0.19
Internal Reports Prepared by Staff	5.00	1.75	5.00	1.91	0.00
Internal Training Sessions	5.42	1.26	4.69	2.01	-0.72
Industry Seminars and Courses	4.46	2.17	4.58	1.19	+0.12

Table I (cont.): Results of Information Scanning Surveys. Each "Source of Information" was ranked on a seven-point scale that indicated the importance of these sources in professional decision making and problem solving. (Scale: 7 - extremely important, ..., 1 - not at all important) Note: changes in ranking may appear inaccurate at the .01 decimal place due to rounding of reported results.

CONCLUSION

Access to global information fundamentally alters the information scanning function of decision makers. The flattening of the management pyramid means information scanning of external sources is being performed by personnel in middle and lower levels of management, not only in the traditional "senior" level of managers. Both graduate and undergraduate classes in information systems can effectively address the use of external information scanning through the teaching of Internet skills.

The Internet exposes students to international information. The process is not contrived as an "international" segment in a course which is otherwise functionally oriented. Students learn the tools of searching for information in the context of a problem they are trying to solve. The fact that information is housed in a database located in a foreign country, assembled by a foreign government, stored in a foreign language, or accessed via hardware/software in a foreign country does not change the importance to decision-making. Use of the Internet brings understanding that information on a computer network is a global resource.

Access to on-line information resources changes the decision makers' choice set. Information sources change and the relative importance of those resources also changes. Key issues about the change in information resources must address the accuracy of such information (as of yet this can be a problem for Internet resources) versus the amount and richness of the information.

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Creating Multimedia Material to Support the Teaching of Data Modeling

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Abstract

This paper will describe the author's experience creating multimedia material designed to help teach data modeling, specifically Entity-Relationship (ER) modeling. The purpose of the project was to provide presentation material that could be used by different faculty to teach the basic concepts of ER modeling and illustrate the technique with examples. Support for this project was provided by a college "Multimedia Mentorship" summer program. A demonstration of the teaching material will be given.

Introduction

Multimedia is a technology that is finding lots of applications in educational settings. The attractiveness of the graphics and the ability to utilize different media contribute to high quality teaching material. The nonlinear sequencing available through hypertext capabilities provide flexibility in how the material can be used. Although a lot of multimedia educational materials exist, very few are for computer related topics.

Faculty are always interested in materials that will facilitate their teaching and improve the delivery of instruction in the classroom. In some cases, especially for introductory courses, the textbook publisher will routinely supply a large variety of useful supporting materials. However, for more advanced courses, the textbook publishers generally provide very limited supporting material, if any. Therefore, faculty often must develop their own teaching material or do without.

This paper will describe the author's experience creating multimedia material designed to help teach data modeling, specifically Entity-Relationship (ER) modeling. The motivation for undertaking this project included several factors. The author wanted the opportunity to learn more about multimedia after sitting through a multimedia course. In addition, the college dean was promoting the development of multimedia instructional materials through a summer program. A third factor was the opportunity to create instructional material that would take advantage of the author's expertise in data modeling and make it easier for less experienced faculty to teach the Entity Relationship modeling technique.

Project Description

At the author's university, the junior level systems analysis and design course had been updated to include the teaching of data modeling techniques, in addition to process modeling. Previously data modeling had been taught only in the database courses. In addition, a major curriculum revision was underway that would move the introduction of ER modeling to the sophomore level. Some of the faculty teaching the systems courses were much more comfortable with process modeling since they had limited experience with data modeling and text material on the topic was minimal. After being asked by several faculty for help in learning ER modeling and being asked to guest lecture on the topic, the author concluded that some ER teaching materials would help these faculty be more effective.

Fortunately, the college dean was sponsoring a summer "Multimedia Mentorship" grant program in an effort to improve the delivery of instruction in the classroom. This was a competitive program which assisted faculty in the development of multimedia instructional materials to enhance their classroom teaching. The support provided by these grants included technical support from a multimedia faculty expert and his student assistants and a small salary stipend. Presentations were scheduled at the end of the summer to generate enthusiasm among faculty for the possibilities of multimedia and make the successful applicants accountable. This dean had also allocated funds over several years to create several smart classrooms so that classrooms were available where the teaching materials could be used.

The objective of the author's project was to provide lecture presentation material that could be used in various department courses, taught by different faculty, to teach ER modeling. The developed material needed to cover the basic concepts of ER modeling and illustrate the technique with examples. It was estimated that more than 200 students in 3 different courses would be served annually by the ER Modeling material.

The Development Process

The development methodology followed for this project consisted of the following steps: determining the main concepts or topics to be included, conceiving ways to most effectively present each concept or topic, selecting the multimedia software, designing the standard screen interface, drafting the content of each page, and creating and testing each page. To get started on this project, the author examined the overheads used to teach ER Modeling in the database class which had also been developed by the author using just word processing and a simple graphics package. After identifying ways that the most important concepts and topics could be effectively presented, a list of multimedia features needed for this project was compiled. Since lots of ER model diagram fragments would be needed in the instructional materials, the ease of creating these diagrams should be a factor in selecting the multimedia tool.

The necessary features were identified as nonlinear navigation, pop-up windows, pages that included pictures and clip art, and easy graphics to create ER diagrams. A simple menu structure was used to organize the material into cohesive teaching units that would be meaningful to an instructor. Pop-up windows would be used to display details about an object or give an explanation or further information that would aid understanding of the concepts being illustrated. There wasn't a real need for audio or video in this project. There was no convenient source of videos on data modeling that could be excerpted for this project.

A number of multimedia software tools were available for faculty to use in developing their materials. Both Toolbook and Freelance Graphics were considered for this project. Freelance was selected because it seemed adequate, would be simpler to work with, and was expected to have a shorter learning curve. Freelance has a button feature that allowed menus to be created and provided the necessary nonlinear navigation capability. The advantages of Freelance were: no need for programming in a script language, the simplicity of entering text and creating pages using a template, the ease with which graphic images could be included, and the ability to easily print nice student handouts. There was no convenient way at that time to create handouts from Toolbook materials. Freelance had some limitations since it is not as sophisticated or as flexible as Toolbook. Pop-up windows had to be simulated in Freelance by duplicating the page and superimposing the window on the copied page, but the effect looked like pop-up windows.

The teaching materials were created over a two month summer period. Although some technical assistance was used, the author did almost all of the development. This was the author's first multimedia project and considerable time was spent thinking about how to effectively present the ER concepts and best take advantage of the features available.

ER Modeling Content

A number of example pages from the presentation material are included in this paper to give the reader a feel for the teaching materials developed. The demonstration planned will illustrate a more complete portion of these teaching materials.

The content of the lecture presentation material was divided into 4 main sections, named *Introduction to Modeling, Entity Relationship Model Basics, Developing an ER Model,* and *Advanced Modeling Concepts*. A main menu page presented as a "Table of Contents" was set up. Each section was then subdivided into teaching units with a submenu page starting the section. This menu hierarchy provided faculty quick access to each section and teaching unit.

For example, the *Entity Relationship Model Basics* section had the following units: Introduction to ER, ER Components, Relationship Types, and Example Model. Figures 1-7 show pages from this section. Figure 1 shows a page from the ER introduction unit. Beginning students often have trouble distinguishing between an entity type and an entity occurrence. Figure 2 effectively illustrates the difference. Two pages from the Relationship Types unit are displayed in Figures 3 and 4. The concept of many to many relationships is developed using a series of pages. Figure 4 is making the point that there may be data attributes about a relationship and illustrating the point with an example students can relate to.

In teaching ER modeling, students are generally taught to read an ER model before they will be expected to create one themselves. The last unit in the *ER Model Basics* section is an example model which the instructor can walk through in class. The example ER diagram used is shown in Figure 5. Each data model object (entity or relationship) was made into a button. When an object is selected, a pop-up window is displayed that lists the attributes for the entity (Figure 6) or the business policies that correspond to the relationship (Figure 7). The instructor is not forced to walkthrough the model in a fixed way, but can vary or repeat the objects selected depending on how well the class is catching on to the concepts.

The iterative nature of data model development was the focus of the *Developing an ER Model* main section. Figures 8-10 are shown as examples from this section. Figure 8 describes the steps in the development process. The major objective of this section is to illustrate the process of building an ER Model. The situation used was a video store which works as a good first example because most students are familiar with the business setting. To obtain appropriate pictures to convey the business scenario, scenes were shot at a local video store. Digitized pictures were then added to pages (Figure 9). The teaching materials illustrate the creation and evaluation of several versions of the data model. Figure 10 illustrates the diagram changes as version 1 becomes version 2. This unit also illustrated the process of determining the placement of data attributes required for the system and ended with a complete final model.

Reflections on the Experience

The ER instructional materials developed by this project have been used by the author and a number of other faculty in both graduate and undergraduate courses where Entity Relationship Modeling needs to be taught. Faculty have been pleased with the results. They thought that the clip art, pictures, and high quality diagrams made the pages attractive and effectively communicated the concepts. These materials were a lot more professional looking than the earlier database class overheads on ER modeling. Since the lights had to be turned off in order to see the projected material, the students were pleased with the handouts which were easy to create. The instructors had sufficient flexibility in how and when they used the individual teaching units and in determining how much of the detailed information available with certain examples would be used in their presentations. The second semester in use, the material was stored in a non-updatable mode on the department network and made available to students for individual review.

There were also some lessons learned for future projects. The color scheme selected for the project which looked great on an individual computer didn't project well in the smart classroom generally used by the department. There was not enough contrast between objects, the basic blue background color was too dark, and the power of the overhead projector being used wasn't powerful enough to project a clear image for students in the back row of a 30 seat classroom. A graduate assistant eventually modified the materials for a new color scheme which works much better. The department has also obtained a more powerful overhead projector in its smart classroom.

A second disappointment resulted from trying to create a runtime version of the material. The buttons which were used extensively to provide nonlinear navigation were disabled when the runtime version was created. Therefore, Freelance was needed to view the material.

As a first experience with creating multimedia material to support teaching, this experience was very successful. Although only limited multimedia features were used in this project, the desired ER concepts and examples were effectively illustrated. The author gained both an appreciation for how multimedia could be applied to teaching computer related topics and valuable experience with a relatively simple multimedia tool. Additional, more sophisticated multimedia materials have since been developed within the department for use in other courses.

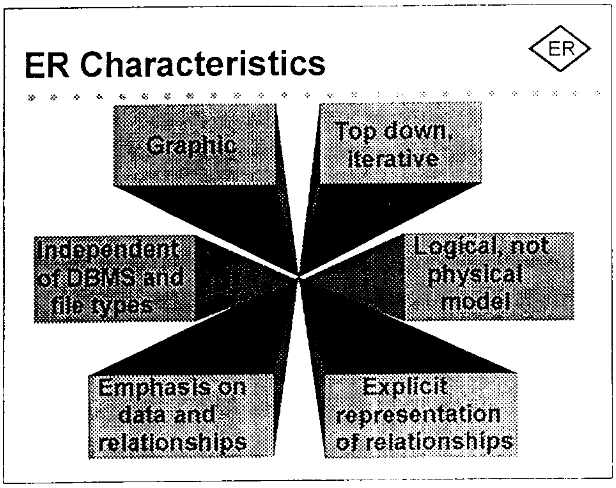

Figure 1

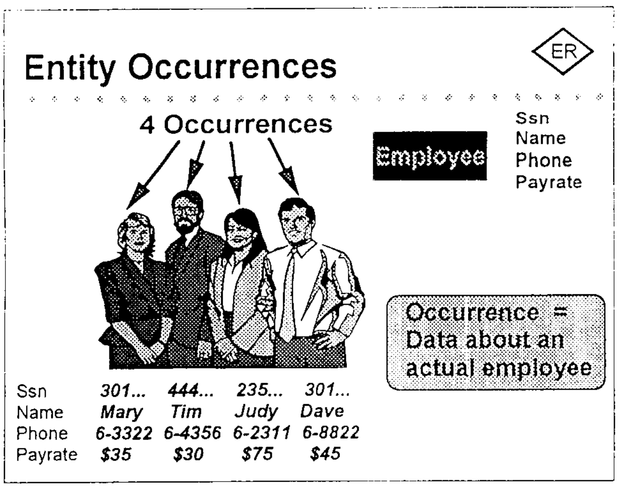

Figure 2

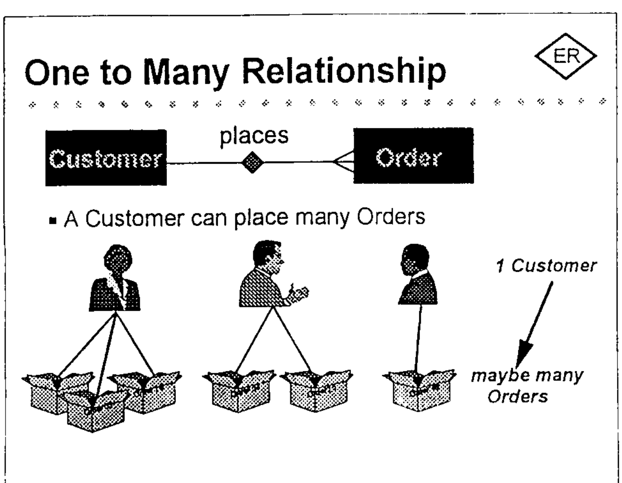

Figure 3

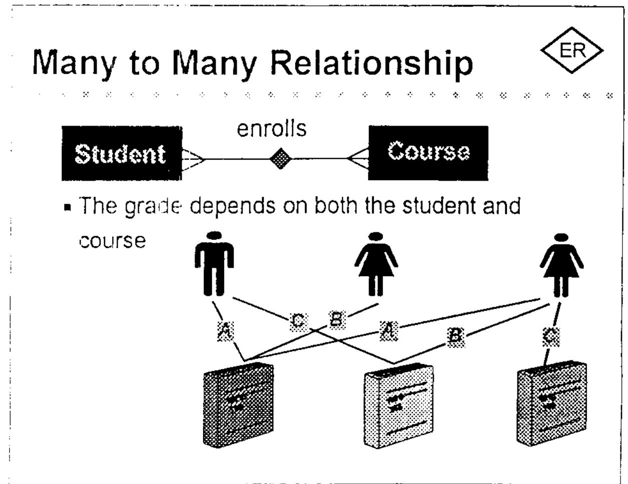

Figure 4

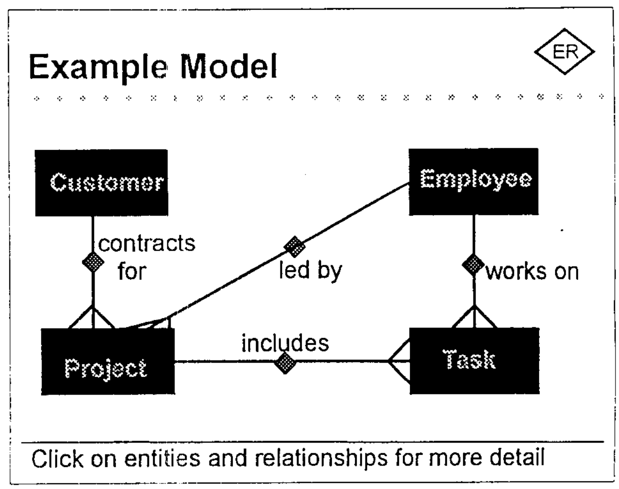

Figure 5

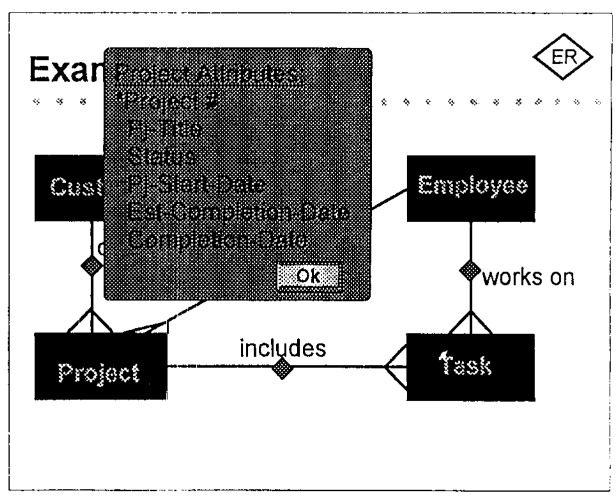

Figure 6

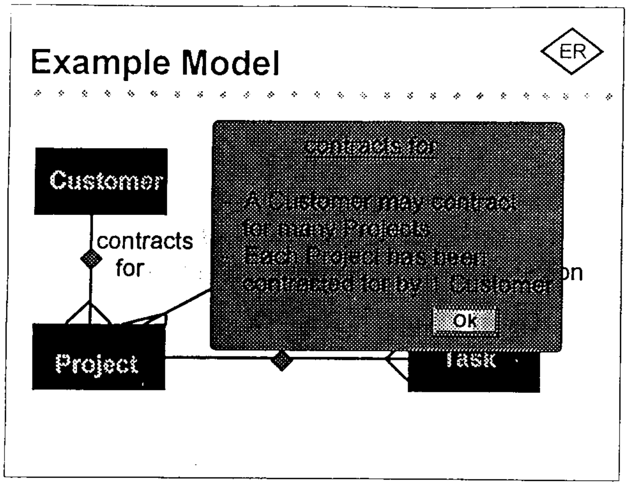

Figure 7

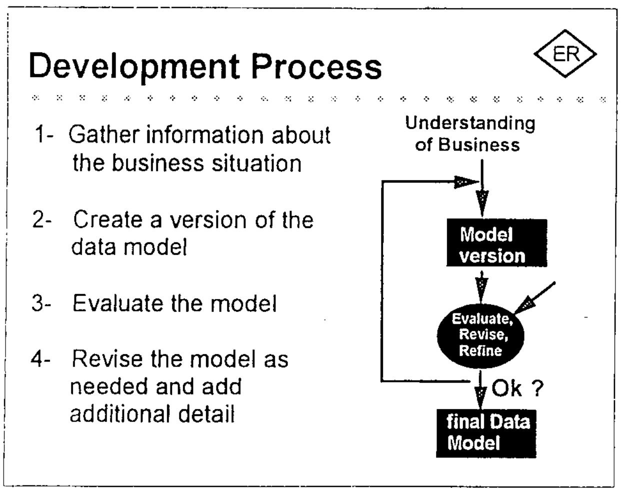

Figure 8

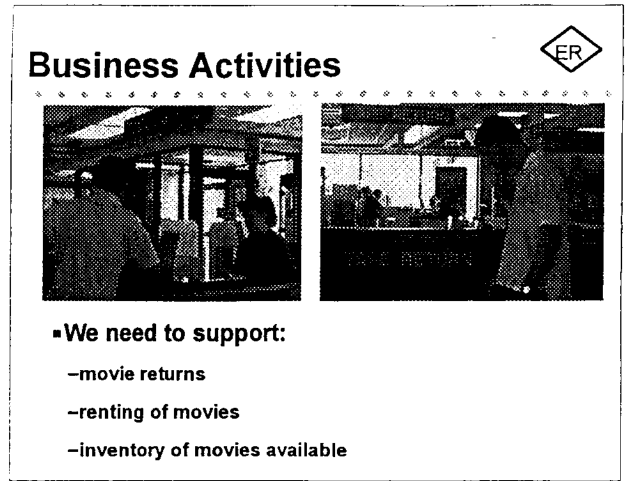

Figure 9

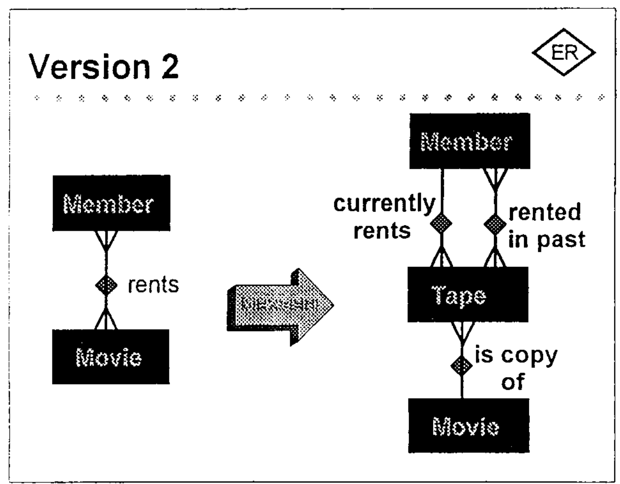

Figure 10

WORKFLOW As An Instructional Technology: Enabling Business Strategy With Information Technology

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ABSTRACT

This paper describes the introduction and effectiveness of using a workflow management technology within an MBA course which emphasizes the role of information technology as an enabler of business strategy. The students participated in a class project which gave them the ability to operationalize the business processes they analyzed and designed by using a workflow management technology (WFMT) to model the business processes. The WFMT utilized was based on object-oriented technology and interfaces which did not require the students to be programmers, permitting the students to concentrate on the business issues rather that the technical details of the program.

INTRODUCTION

As organizations are being forced to streamline their operations, management is challenged with increased organizational complexity. In their effort to remain competitive and orchestrate these complexities, organizations have shifted their focus inward toward improving business processes (Cash et. al., 1994). The examination of business processes focuses on the coordination and integration of workflow. This paper describes the introduction of using a workflow management technology within an MBA course which emphasizes the role of information technology as an enabler of business strategy. As educators we must keep our students abreast of these methods and enabling technologies.

ORGANIZATIONAL NEED FOR WORKFLOW MANAGEMENT TECHNOLOGIES

Organizations today face an environment that requires them to create ways to coordinate, collaborate, and integrate information horizontally across specialties and functions in an effort to facilitate business processes. Information technologies such as workflow have emerged from the awareness that information needs to be shared to empower the organization and individuals within a diverse work force. In addition, these individuals need coordinated access to this information with improved communication among themselves to support enterprise operations (Roberts, 1994).

As a result, organizations have shifted from the traditional vertical structure, where groups are arranged by function, to a horizontal structure with an emphasis on teams, which are shaped around business processes (Regan and O'Connor, 1994). This introduces the increasing need for process management. The successful management of processes involves the ability to manage the efficiency and effectiveness of workflow. The management of workflow is assumed by individuals in a process team which disseminates managerial skills across the organization (Regan and O'Connor, 1994). This increases the need for information technologies to assist in the management of workflow for non-IS professional as well as IS professionals.

What Can WorkFlow Management Technologies Do to Address These Needs?

In general, WorkFlow management involves business process redesign and a focus on organizational needs. The process, or flow of work, determines organization structure while creating transparent department borders, making staff aware of the organization as a whole (Neuman, 1994). A WorkFlow Management Technology (WFMT) must be able to support the ability to redesign processes and support organizational needs such as manage uncertainty, support adaptability, be easy to use, be flexible, manage change and complexity, and allow for flexible individual collaboration. Many information technology tools and applications exist which provide assistance to one or more of these needs, however these tools may not be integrated or do not support the continuous improvement of day-to-day workflow needs. Recent WFMTs integrate workflow modeling and process changes, mange the interaction of various Information Technology (IT) tools and applications (such as groupware and legacy applications), while coordinating the collaboration of resources needed for each task within a process.

The current WFMTs have the ability to address many organizational needs because of the following strengths:

(1) contains the process knowledge which facilitates the appropriate integration between end-user, applications, technology, databases, and external links; helps manage change by managing the integration.
(2) has the ability to optimize and integrate legacy systems through an open architecture or connection and collaboration.
(3) assists modeling alterations and management by developing in varying degrees of modularity without extensive programming skill.
(4) allows for flexible individual collaboration, and differences in human decision making. The major strength of individuals in organizations are their abilities to combine skills through collaboration and coordination in addition to the ability to seamlessly utilize existing data and applications to assist decision making (Antonucci and Bender, 1995).

The WorkFlow Management Technology Choice

The WFMT adopted within the MIS curriculum was FlowMark(TM) from IBM for its ability to address the many organizational needs mentioned in the last section. A University and Corporate alliance was formed between IBM and Widener to facilitate the use of this new technology within the University setting. FlowMark was able to assist in identifying a bottleneck, analyze how it affects the process, deploy the appropriate business process model tool or workflow tool to improve the bottleneck, then alter the process to improve aspects which may be effected by the changes.

This allowed for the students to continually analyze the process in an effort to facilitate continuous process improvement.

FlowMark also fully utilizes object-oriented concepts which gives it the ability to define a set of common operations for a class hierarchy (such a bank loan), then respond in different ways to the common operations without redefining the operations (Antonucci, 1994). This also enables FlowMark to define processes in various levels of granularity. Therefore the entire process does not need to be fully analyzed before implementation, giving the students the ability to analyze and implement simultaneously. Also, since FlowMark has an open architecture, allowing the integration of other tools and applications, the students were able to use a simple screen painting application (Watcom VXREXX) and a database (DB2/2), to provide the screens and data repository needed within procedures of tasks. The WFMT (FlowMark) became the coordinator of these additional resources. As a result, the sub-processes managed by FlowMark were flexible in terms of who performed them, thereby allowing for a variation in personal preferences of decision tools.

FlowMark also was able to set the parameters for organizational components such as the roles, the people, and the business rules which represented the business processes within the business strategy of the organization. Once this build-time model is defined, then the end-users can utilize the run-time model to change any of the business or task components while FlowMark automatically notifies or changes other tasks and components which are affected. The user manager may monitor the entire instance of a process and make alterations to facilitate the fruition of the process. This not only permits management to operate more efficiently, it allows support level management to simulate the results of changes in business rules, goals, or missions.

In general there are many areas in an organization in which a WFMT such as FlowMark enhances:

(1) assists managerial decision making and identifying areas for continuous improvement by analyzing and tracking process efficiency and effectiveness.
(2) assists process management activities such as inquiries, documentation, status checks.
(3) assists process analysis and design by allowing the implementation of varying levels of processes analysis (the entire process does not need to be analyzed prior to implementation).
(4) assists application development by interfacing and integrating with other applications.

INSTRUCTIONAL METHODOLOGY

There is a consensus in the literature that there has been a rise in end-user computing and a change in the role of practicing Information Systems professionals (Dawley, 1991; Jackson, 1992; Wiersba, 1991-1992). As information technology is becoming embedded in everything we do and disseminated throughout organizations, it is important that managers of all levels and all functions within the organization know how to manage with information resources (Martin et. al., 1994). At the graduate level it has become evident over the past few years that more students from other disciplines and backgrounds, other than MIS, are enrolling in MIS courses, supporting this claim. Therefore, the teaching methods used took into consideration a diverse student class-mix from various managerial and industry backgrounds. As more of the non-IS professional becomes more familiar with Information Technologies, there is a larger need for the IS professionals and the non-IS professionals to form a partnership. The teaching methods were designed to foster this partnership between IS and other disciplines by integrating the two types of students into the same MIS course, providing vehicles such as projects and teams to encourage collaboration, coordination, and information integration.

The first course to use workflow management technologies was an MIS course with in the MBA curriculum titled Managing With Information Resources. The focus of the course is on methods and tools which support the planning, management and coordination of various interacting organizational components in an effort to improve the competitive position of the organization. Topics included the theoretical and practical implications of business process reengineering and continuous improvement. The goal was to support these recurring topics with information technology tools which allow students to implement and track business processes. In an effort to achieve these goals, a combination of readings, papers, and 2 whole-class case projects were deployed.

Course Content

It is important to realize that workflow management technology success begins with the proper organizational analysis and understanding of the organizational complexities, then how to enable the strategy with the tools (Antonucci and Bender, 1995). To this end, the course began with the proper introduction to analysis methods emphasizing the role of information technologies. Readings and papers were assigned to facilitate the students' basic understanding of the various technologies and methods. The remainder of the course material was facilitated by using 2 whole-class case projects. The general course topics are listed in figure 1.

The cases were based on existing organizations, one being a furniture manufacturing company, the other a hospital. The diversity of the cases was planned such that both the service and manufacturing industries could be compared in terms of their workflow management and strategic IT roles in enabling business strategy.

FIGURE 1 - GENERAL COURSE TOPICS

1. Introduction and review of competitive information system, the changing organization and the emerging role of information technologies. Cases assigned.
2. Organizational evolution of IT; Alignment of IT and corporate strategic planning; IT-enabled business trasformation. Case role assignments, define the mission, objectives, goals.
3. Business models and information architecture planning; Business process and systems analysis; Application planning and development. Case-defining the architecture and the processes.
4. Workflow analysis and design; WFMTs; Group-enabled applications. Case-defining the processes.
5. Implementing workflow using FlowMark™. Case-Defining processes.
6. FlowMark design, modeling, animation. Case-defining processes.
7. Process modeling with ITs; The Growing importance of object-oriented technologies. Case-modeling the processes.
8. The growing importance of intelligent systems. Case-modeling the processes.
9. Managing technology integration. Case-modeling and integrating applications.
10. Evaluation and Control. Case-analyzing the processes.
11. Continuous improvement; Management issues. Case-refine the processes.
12. IT trends; Global IT Management ; The technical advantage. Case-wrap up. Case presentations and discussion.

The students were each assigned specific organizational roles, such as the VP of Finance, in addition to various modeling roles as shown in Figure 2.

FIGURE 2 - MODELING ROLES

The team should divide the following two roles among the members (e.g. if there are 6 team members, 3 should be assigned the PROCESS IDENTIFIER role, and 3 the ROLE IDENTIFIER role):

PROCESS IDENTIFIER - identify the business processes: define activities which make up the processes - this includes the data and activity (work) flow which make up the processes.

ROLE IDENTIFIER - concentrate on formulating the roles (operation roles not managerial roles), then define the people from the operational side of the business who fulfill those roles.

The team should also identify those members who will be the best candidates for the following additional roles:

1. **INTEGRATOR**-when the roles and processes have been identified then there is a need to assign the identified roles to various defined business processes.
2. **TRANSLATION SPECIALIST** - translate and animate process models within FlowMark-testing, quality assurance, and rapid changes.
3. **SCREEN SPECIALIST** - create screens to capture data - interface - integration of processes - create screens to collect data and store that data in FlowMark data containers.
4. **PROCESS BUILDER** - when time comes to begin rapid prototyping of initial process models, a process builder role needs to be defined and an individual needs to be assigned to this role (this role should be rotated among the members).- Primarily work with FlowMark to create processes to mimic the daily operations of the organization. a screen specialist will assist the process builder. This should be started as soon as possible.

The student teams proceeded to analyze their perspective cases using a top-down approach, identifying the corporate mission, goals, and business strategy. Then the business processes necessary to enable the business strategy were identified. Due to time constraints of the course, the students selected one business process for each case to analyze, design, and implement using the WFMT. The hospital team chose the process of admitting, treating, and discharging a patient (See Appendix A for the completed build-time model). The manufacturing team chose the process of manufacturing a custom order for a customer (see Appendix B for the completed build-time model).

The cases enhanced the students' learning in many areas;

(1) it allowed the students to 'experience' the strategic planning methods presented by utilizing them in the initial case analysis.

(2) it made the students aware of the difficulties involved with proper business process analysis (it took the students three class periods before they realized the difference between vertical and horizontal process analysis).

(3) it made the students' aware of the differences and similarities between organizational components such as people, roles, tasks, procedures, organization, structure, and applications; and the importance of coordination and collaboration of these components to facilitate workflow for decision needs.

(4) it made students' aware of and experience using various ITs such as databases, client/server architecture, networks, object-oriented concepts, Graphical User Interfaces, etc... at an applied level.

(5) it allowed the student to experience how WFMTs can help track, portray, monitor, and manage a business process so that it can be continuously improved.

LIMITATIONS AND FUTURE ENHANCEMENTS

The WFMT used was very effective in analyzing and implementing the identified business process. The most difficult portion of the course was the first 3-4 weeks prior to using the WFMT, which were spent analyzing the organization in an effort to identify the critical business processes. Traditional analysis methods were deployed separately from the WFMT. At that time the discussions and analysis efforts were the sole method of 'bridging the gap' between strategic process planning and operational process implementation. However, next semester a new IT tool which is part of the IBM workgroup family will be utilized to 'bridge this gap'. This tool shows promise in the ability to assist in the modeling of strategic corporate goals and processes, then automatically generate the initial build-time model with the WFMT.

CONCLUSION

In this paper, I have introduced the need and an approach for incorporating workflow management technologies into the curriculum of business schools. The integration of process analysis, process design, and workflow implementation promotes the student's understanding of how information technologies enable the business strategy. This approach supports the notion that WorkFlow Management Technologies (WFMT) can be used within a classroom setting to support the concepts of how Information Technology can enable business strategy. An Instructional methodology was introduced utilizing a WFMT which was able to combine the diverse backgrounds of the student population effectively to enhance learning for the entire class. There was a very positive response from the students at the end of the course expressing the direct correlation between the application of WFMT in the classroom to the immediate needs of their perspective work environments.

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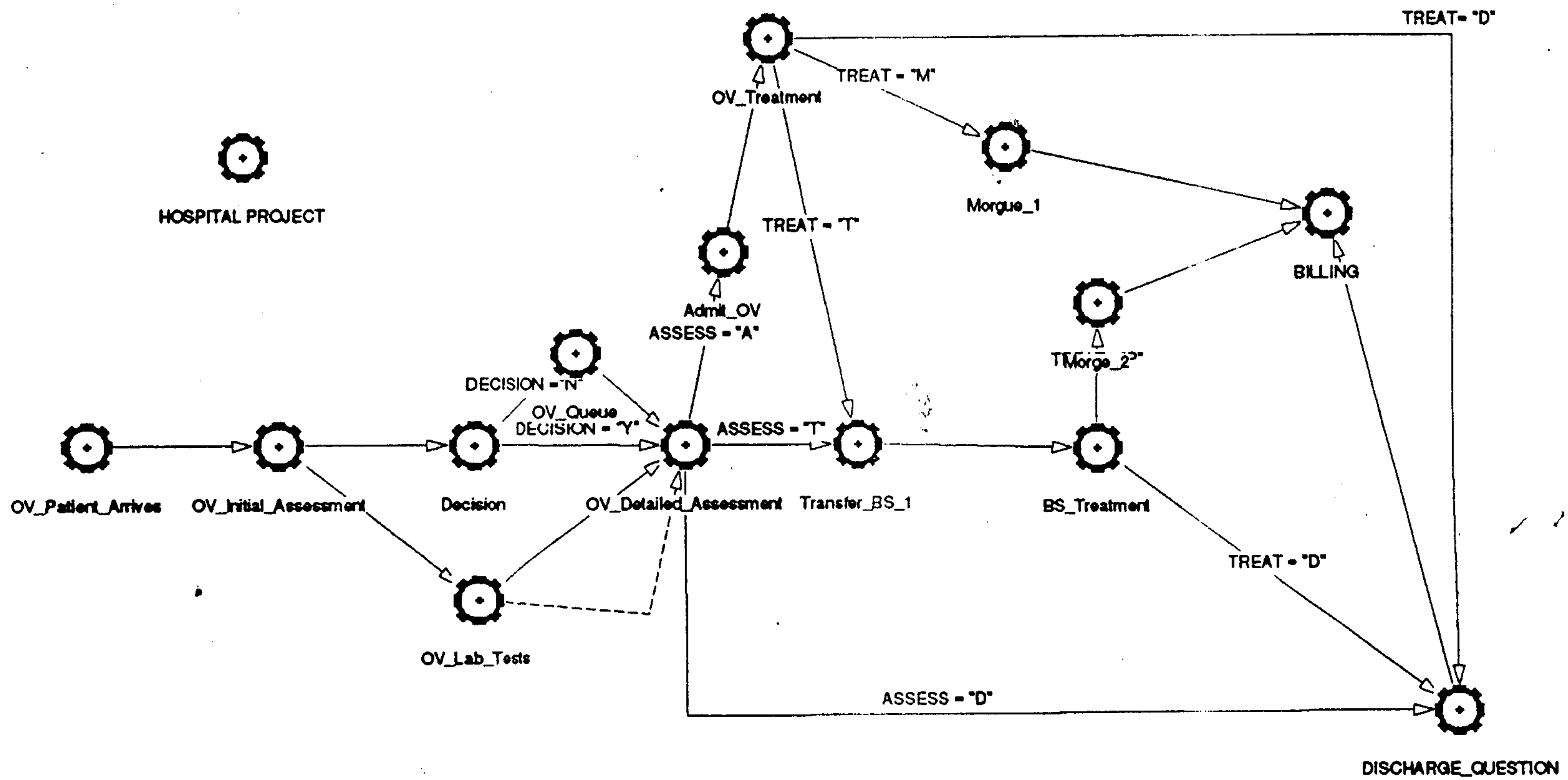
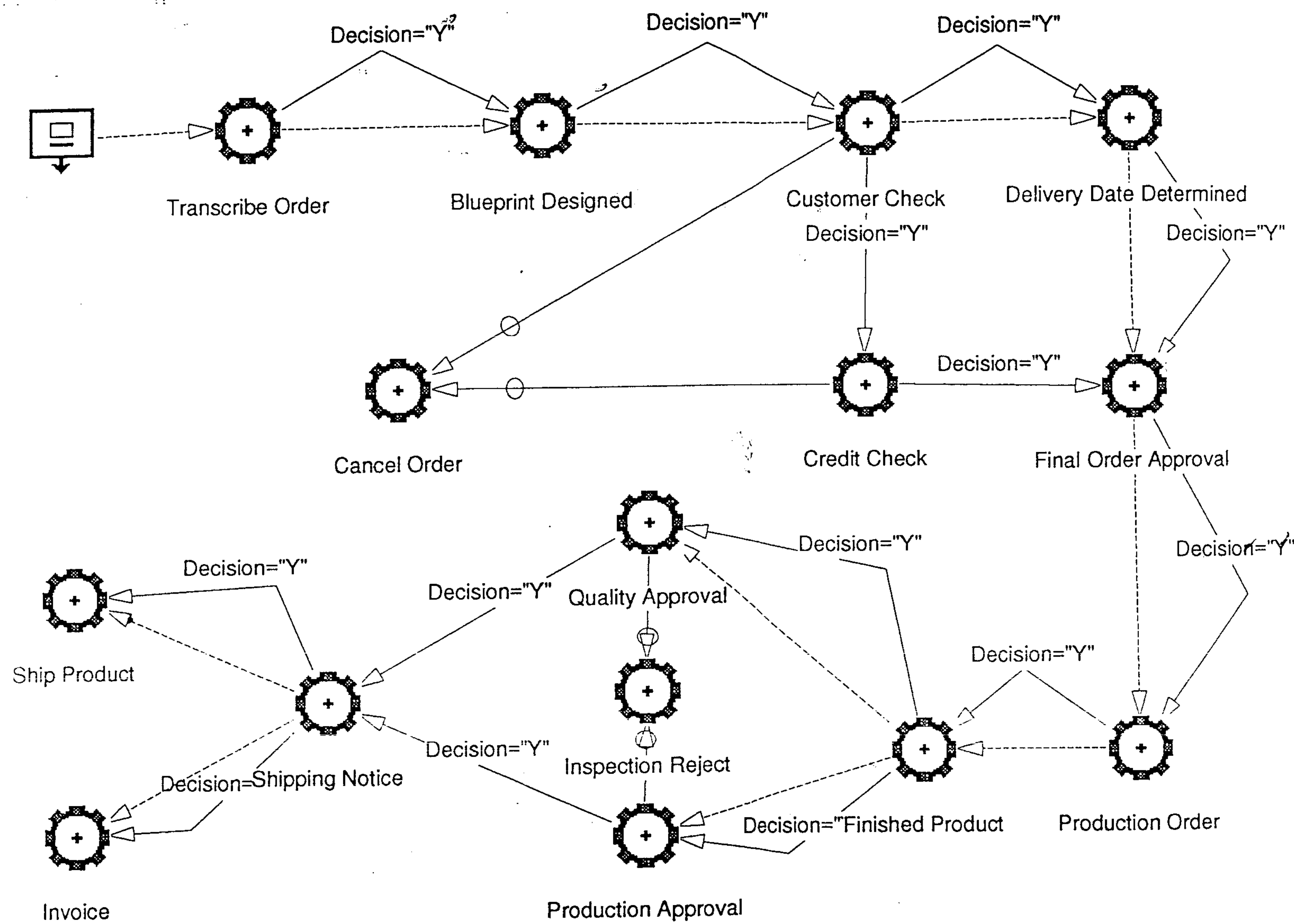


APPENDIX A - COMPLETED BUILD-TIME PROCESS MODEL OF THE HOSPITAL CASE DEVELOPED IN FLOWMARK



APPENDIX B - COMPLETED BUILD-TIME PROCESS MODEL OF THE MANUFACTURING CASE - DEVELOPED IN FLOWMARK

The Internet as a Teaching Tool

PANEL SESSION

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The Internet will be presented with an overview of the terminology and available teaching aids plus examples of use for a variety of settings and courses. Several lists will be presented and available for attendees which deal with textbook references, general trade book references, and general sources of material to aid faculty in using the information highway. The currently used sites for instructional purposes will be noted and available from a technical/information systems view and a general view emphasizing business subjects. Basically, a two tiered approach will be presented on using the Internet in classes. After a general introduction, one presenter will show how web sites are used from the specialized information systems courses and graduate business courses and the other presenter will demonstrate uses from the introduction course level through business classes with some notations to how other disciplines are using the tool.

Getting on the information highway will be discussed from the academic setting plus other avenues such as CompuServe and America On-line. Experiences will be noted with various connection situations encountered in the academic setting. In the same manner, modem versus direct connections will be presented from a text and graphical mode of examination. All settings will provide an emphasis on notations of using e-mail for communications for the current class setting and "talking" with friends around the world. UNIX versus shareware/freeware versus commercial packages will be shown with an analysis of those mail packages which have been used within at least three academic settings.

For the lowest level, e-mail is a mode to have students communicate with peers and family members. This has been done from elementary through graduate level settings. Every student in information systems courses have an account either from the university, company setting, or an on-line service. Any student, alumni, faculty, or staff associated with the university is eligible for an Internet account. The mail is used in almost all facets of the institution for internal and external informal communication. A list of useful web sites are presented in the first general education course from which assignments are given to explore the world wide web.

Groupwork cases will be noted that required e-mail as a vehicle to communicate work on a solution. Assemblage of end results outside of a face-to-face setting will be explained. Situations which have used company intervention [from the use of part-time faculty and colleagues] will be provided as examples. Participants will be polled to provide any experiences which are similar to the presenters use of the net.

In the information systems view, a "how-to" approach will show how the web sites can substitute for textbooks and other sources in providing resources for decision making. Cases will be noted that have been used in course setting which required students to find various data with a library view of the Internet. Search engines will be noted plus web sites which connect to various major vendors in both software and hardware. Even legislative aspects are examined in the courses to show what the current laws allow. The LAN management course does not use any textbook but material from various web sites to supplement lecture and hands-on assignments. Experiences will be related using the interchange of questions and answers of the web sites.

INVITED KEYNOTE ADDRESS

IF IT TAKES 40 OR 50 YEARS CAN WE STILL CALL IT A REVOLUTION? MANAGING TRANSITION: THE INEVITABLE INTEGRATION OF INFORMATION TECHNOLOGIES AND EDUCATION

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ABSTRACT

Our society and its system of schools, colleges, and universities are undergoing a major transformation. This transformation is inevitable, irreversible, and unpredictable; although we can still influence its direction. The emergence of new information technologies is neither the cause, the purpose, nor the consequence of this transformation. However, an important element of the transformation can be guided in part by our own thoughtfulness and decisions about the role of technology in education.

Ever since the 1960's there have been claims that computers are about to revolutionize education. Why haven't these claims already been realized? Why should we continue to invest time and money in educational applications of information technology? How can we be sure the claims won't fizzle out this time, as many have in the past? What should academic leaders be asking and doing about using informaiton for teaching and learning? How can an individual or an institution manage a transition without a clear vision of the goal?

Teaching, learning, and scholarship are at the center of higher education. Technology can be their servant in the process of transforming education. Any change that is viewed only as a technological revolution in education wil fail. The most fundamental challenge raised by the increasing attractiveness of educational applications of information technology is managing the institutional transiton toward an end-state that seems both inevitable and uncertain.

This presentation will offer observations, ideas and recommendations that address these questions and issues -- based on material emerging from the new Teaching, Learning, and Technology Roundtable Program of the American Association for Higher Education.

CLIENT/SERVER TECHNOLOGY PAST, PRESENT, & FUTURE

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ABSTRACT

Client/Server technology is the wave of the future. It gives companies the ability to maintain mainframe-sized databases while still having the user-friendly environment in which to manipulate the data. There are many benefits and costs to implement client/server computing. Among the major benefits are the ease of database access, shared hardware and software resource, its scalability and increased application performance. These benefits are partially offset by major barriers, such as cost, an immature technology and established IS culture. Looking ahead, technologies such as data warehousing will take client/server to a whole new level. But, client/server is not for everyone, especially if capital outlay is an issue. File Server technology or outsourcing may be the road to take.

INTRODUCTION

The term Client/Server is one of those terms that everybody has heard of, but no one has a clue what it is. Chances are that these people know it has something to do with computer technology -- probably along the lines of "my computer is one my **clients** who happens to **serve** me." For all intents and purposes, this remedial definition is not that far off base. So what is the real definition of Client/Server? According to a vendor-user educational organization known as the Client/Server Round Table, this term refers to "a system in which programmable workstations perform a substantial portion of the application processing, but obtain application services from other processes on a network." In other words, it is typically network-based computing in which work is split between a personal computer (the client) and a more capable shared computer (the server).[1] It gives users the responsiveness, familiarity and ease-of-use benefits of a personal computer (PC) with the performance, reliability, data integrity, and security of a mainframe, coupled with its ability to support many users simultaneously. This is why 43% of the Fortune 1,000 implemented Client/Server technology during 1992.[2]

The initial drive to Client/Server came from what used to be known as "End-User Computing." Companies would invest their money in PC's, software, printers, and eventually networks to facilitate file sharing. These were steps in the right direction, but eventually the limitations of this type of environment became apparent. There had to be a way to get more processing power to handle industrial-sized applications while retaining the familiarity, ease-of-use, and end-user control that people were accustomed to. That's where Client/Server came in!

The remainder of this discussion will focus on the Past, Present, and Future of Client/Server Technology. Issues such as Benefits and Drawbacks (cost being the most prominent drawback), New Technologies and Alternatives will be discussed later in this paper.

THE PAST

New technologies usually supersede a prior technology that no longer satisfies the needs of the end-user. A good example of this is how we listen to music. In the 50's and 60's, we would put our vinyl album on the turn-table and the music suddenly appeared before us. In the 70's, we turned to 8-track and cassette tapes for their clarity and mobility between the house and the car. But we still demanded something better. Along comes the compact disc in the 1980's. Music that is digitally recorded is as clear as it gets. I can even put them in my car, or load ten disks at a time in my home stereo. This exemplifies how technology continues to satisfy the end-user.

Client/Server is also the effect of some near-obsolete technology--called *mainframes*. In the modern business environment, the mainframe is not flexible when faced with change. Information processing is becoming the major factor in establishing a competitive advantage. It is key to such new-wave management techniques as just-in-time inventory, total quality management, and business process reengineering. Increasingly, corporate computing will have to zig, zag, and then turn on a dime. Mainframes can not do this. Reprogramming mainframes to spit out information in new formats can be very time consuming and expensive.[3]

THE PRESENT

But there's no sense dragging up the past. What is important is what Client/Server can do today. As mentioned earlier, Client/Server refers to a group of client PC's or workstations tied together, so they can swap data, and one or more computer servers that hold databases for the network along with the programs that manage it. This sounds great, but a good management team does not just jump into something new without examining how it will affect their business. It is at this point in the discussion where we put on our "management hat" and focus on the pros and cons of Client/Server Technology. It is critical that these factors be addressed when thinking about what Client/Server can do for your company.

Pros

Easy Database Access. Users want fast access to both internal and external databases. Client/Server technology offers transparent access to data through familiar PC screen interfaces, such as database, spreadsheet, word processing, and forecasting packages. A typical client process involves requesting data located on a server with data displayed through a PC software package or application. This is called Desktop Extension; the client/server application is an extension of the user's familiar PC software. A graphical user interface (GUI) typically provides a user-friendly interface for database access.

Shared Hardware and Software Resource. Client/Server computing offers organizations with heavy investments in PC's and LAN's (local area networks) the opportunity to maintain reduced workstation memory requirements because the server can share its processing and storage capacities with clients. Thus, client/server technology offers organizations the opportunity to shift computation-intensive processing to high-performance servers and retain older workstations using 8088 and 80286 technology, though the trend toward GUI front ends has precluded such savings. The typical client workstation is a 486 machine with 8MB or more of RAM and more than 200MB of hard disk space. Organizations with a substantial number of 8088, 80286, and 80386 machines may face considerable expense in upgrading these workstations to acceptable clients.[4]

Scalability. Client/Server technology offers the ability to add computer resources in small bites through upgrades of the server. This ability to scale an application after it is implemented is as important as any functional or performance requirement that can be addressed. Client/Server applications are scalable on both the client and server level. On the client level, systems are scaled primarily by adding or subtracting client workstations and human users. Other client-side changes which can increase system throughput include redesigning the user interface to make it easier (or faster) to use, and moving the user interface to a true multi-tasking operating environment to allow users to process more than one transaction simultaneously. As far as the server level is concerned, application servers can be replicated, and system throughput increased by splitting the workload among a greater number of platforms. Of course, database servers can also be upgraded as demand and data volume increase. In short, the scalability advantage of client/server computing comes from the fact that each component of a client/server system is independently scalable.[5]

Increased Application Performance. There are several reasons for increased application performance. First, since processing is distributed, there are more CPU's to share application processing. Second, network traffic will decrease since data processing at the back-end server reduces the need to send large data files across the network to workstations. Finally, since client machines are typically powerful workstations, local processors can dedicate their resources to local processing and GUI displays.

Increased Management Control. Centralizing data on servers, as opposed to individual computers, will return to the MIS department some of the control previously lost with the resulting improvement in data security and data integrity. Centralization allows MIS to monitor data resources through regular backup procedures, restart and recovery procedures, uninteruptable power supplies, and other management procedures often missing when LAN's are managed by end-users.[6]

Cons

Implementation Costs. Before anybody knew how much this new technology costs, the perception, alone, is the largest single barrier to the adoption of client/server technology. Perceived costs include workstation upgrades, hardware and software acquisitions, and LAN acquisitions. Implementation costs are substantially lower where organizations already have an installed base of powerful microcomputers and LAN's. However, even these organizations may face costs required to upgrade workstations to GUI environments and to integrate systems. These costs will reduce the savings anticipated from the replacement of mainframe and minicomputer systems with client/server systems.

Immature Technology. Client/Server technology suffers from a lack of generally accepted standards and the availability of commercial products. While many server software products are available, only a few client application programs are commercially available. What is standard is a growing set of proprietary standards developed by vendors of their products.

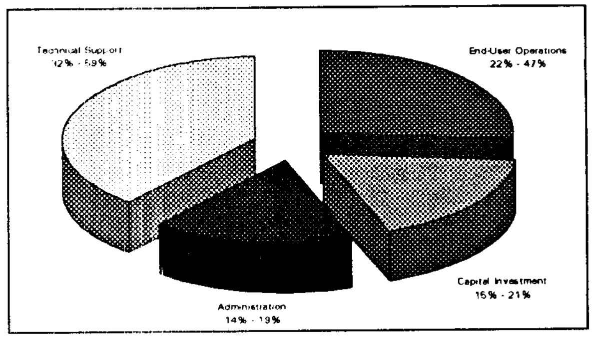
MIS Culture and Fear. MIS personnel may feel threatened by the technology, especially mainframe host staff whose culture does not include PC's and LAN's. This could lead to poor communication between staff supporting downsizing activities and mainframe-oriented staff which opposes client/server application development projects. Personnel well trained in the development of PC information systems and LAN's are more likely to adopt client/server technology than personnel who are tenured in mainframe database applications--though I do not think this applies to many companies these days.

Complexity. The complexity of client/server technology causes some practitioners to avoid this technology. At least two different computer programs must be made to work together and decisions must be made about which CPU will perform what processing. The correct division of labor between client and server in order to maximize performance and reduce network traffic is also a complex issue. The placement of too much data on a client workstation is likely to expose the data to the typical lack of backup and recovery procedures associated with these systems. On the other hand, placing too much data on the server may affect response time since record traffic to client workstations will increase significantly.[7]

Focus on Costs

Like any major undertaking, one of the biggest issues that absolutely has to be addressed is the cost of the project. Client/Server technology is no exception. The market for client/server system software, alone, will grow from $1.4 billion in 1991 to $20.8 billion in 1996. This is a compounded annual increase of 71.5%. On the surface, client/server is almost irresistibly attractive. Internal customers love MIS managers who can rapidly create graphical applications that better capture changing business requirements. Also, it is attractive since the cost of micro-processor-based hardware and desktop applications is so low. Capital outlays for client/server hardware system software and contract maintenance can be one-third to one-fifth mainframe costs for comparable performance. In some situations, such savings can be much greater. David Sherr, first vice president for investment-banking technology at Lehman Brothers Inc. in New York City, says hardware and system software for a 2 billion-instruction-per-second trading system that would have cost $130 million on a mainframe cost just $2.5 million on a UNIX-based client/server system.[8]

The initial price of a client/server installation is usually a bargain, but as much as 80% of the cost comes after you sign the purchase orders. Hidden beneath client/server's shiny surface are many often unexpected costs that, in some situations, can actually make client/server systems more expensive to buy, build, implement, and operate than centralized, host-based systems. The following chart exemplifies these costs:



__Technical Support__. Includes most of the functions necessary to get applications into production and keep them up and running. They include network and system administration, operations, IS training, systems engineering and implementation, technical planning, application support and the help desk.

__End-User Operations__. Activities that directly effect the end-user include application development, data management, end-user training and supplies.

__Administration__. This means everything that needs to be done to keep track of all hardware and software on the network and be sure it's being used properly. This includes inventory management, security, software metering, accounting, auditing, change management and legal expenses.[9]

Hyatt Hotel Example

The following example comes from Jeff Moad's, "Client/Server Costs: Don't Get Taken For a Ride," which appeared in *Datamation* on February 15, 1994, p. 38:

Gordon Kerr, senior vice president of MIS for Hyatt Hotels Corp. itemized some of the costs associated with a new, distributed hotel management system that he is implementing in

100 Hyatt hotels in the United States. The system, based on a commercial packaged allocation, keeps track of 11 local hotel functions, from check-in and check-out to customer billing and event planning. It supports 500 concurrent users on PC's and terminals who are tied into mid-range HP G30 UNIX servers running in each hotel (little sharing of data or synchronization is required between hotel sites). This system does, however, feed Hyatt's centralized financial and customer information systems over the company's fractional T1 wide-area network.

The total system, on a five-year cost-of-ownership basis, will cost Hyatt $44.5 million. Spending for hardware and system software accounts for only 21% or $9.3 million of the total cost. On going spending on software enhancement and maintenance, technical support and hardware maintenance accounts for the bulk of the system's five-year costs, 58% or $26 million. Examining these costs on a **per-hotel basis**, this example offers some hard numbers:

PER-SITE ACQUISITION AND OTHER ONE-TIME COSTS	
Installation and End-User Training	$ 60,000
Hardware - CPU (HP G30)	45,000
50 PC's and Terminals	35,000
Software - Purchased Package	30,000
20 Printers	15,000
Total	**$185,000**

PER-SITE ANNUAL OPERATING COSTS	
Software Development	$ 30,000
Support	12,000
Hardware Maintenance	10,000
Total	**$ 52,000**

Not included in the first set of costs were technical planning and system integration expenses. Kerr says those can amount to as much as $30,000 per site. The per-site operating costs are also understated. Kerr did not include any network-related operations or technical support costs because he says, "they're difficult to divide between all of the applications that use the network." Overall, an additional $65,000 can be added to the per-site expense totals.

As you can see by the cost analysis and this Hyatt Hotel example, the cost of client/server is a significant one. Further financial analysis should be performed to determine whether the acquisition and operating expenses of a system like Hyatt implemented, offset with the savings of maintaining a legacy system, can generate positive economic value added for your company. Positive or not, it is very difficult to quantify how much more a company benefits by using the high-performance, reliable, user-friendly technology of client/server.

THE FUTURE

Now that we know about the Past and the Present conditions of client/server computing, it is time to take a look into the future. More specifically, what a new technology like Data Warehousing is, how it can be used to your company's benefit and other tools that have arrived on the client/server scene. I will also discuss different alternatives to client/server--just in case your company does not enough capital to start a program like I have discussed already.

Data Warehousing

Simply stated, Data Warehousing is the gathering of information used to make business decisions. Data warehousing's current and ensuing popularity is a direct result of the move to client/server computing. Over the years, businesses have generated tons of corporate data that have been locked up on various mainframe systems in a highly technical format that business users find confusing. In a data warehouse, all of this information is integrated and stored in a special set of relational databases that are used strictly for decision support. The data is organized around subjects, such as customers or sales. In addition, as the data enters the warehouse, terminology is made consistent.[10]

Contributing to this interest in data warehousing are creative new tools that help simplify nearly every step of the laborious process. Decision makers have discovered colorful graphical front ends that shield them from the underlying technology and let them manipulate the data in ways they never thought possible. Once empowered, they demand more and more information in order to ask tougher questions. At the same time, relational database technologies have matured, making it possible to perform parallel queries and access data more quickly. Also, new extraction tools have come to the rescue, reducing months or years of manual coding previously required to migrate data from legacy and operational systems to a data warehouse.[11]

Other Tools

Other tools that are emerging on the scene will not necessarily make it possible for programmers to build more sophisticated software, but make software faster and easier for the user. For example, suppose that a programmer, designing a system used to input customer orders, wants a menu option to open up a window in the corner of a PC screen showing how much of an item is in stock. He can specify that window's appearance and function in the detail demanded by a programming language like C, or he can say what he wants in the broader outlines demanded by a programming tool. The tool then handles the clerical detail involved in telling the computer exactly what to do. Tools that use graphical interfaces such as Microsoft Windows and new technologies such as object-oriented software are being employed in these situations. Software companies are now delivering financial, manufacturing, inventory control and customer service applications that have been designed from the beginning to operate on client/server networks

Companies such as ParcPlace Systems and Digitalk are benefiting from a boom in demand for tools based on Smalltalk, a language developed in the early 1970's at Xerox's Palo Alto Research Center. It provides efficient ways to create more complex client/server applications. Visigenic Software, in San Mateo, CA, is working on a tool that will enable programmers to reuse applications written in older languages such as COBOL. Dynasty Technologies is developing aids for those trying to write programs that will run on several different machines. Forté Software is creating tools for use on computer systems that may include on-line information services and electronic files of images.[12]

Alternatives

There may be a case that the computing power of client/server is not an option for the money that you are willing to spend. Smaller companies fit this mold more than larger ones. A very common alternative is the File Server system. Like the client/server system, the file server also involves a centralized server, but there is no split of application processing. The file server effectively functions as a remote disk drive. Both the front and back end parts of the application are performed on the same machine. This means that the slowest processor on the LAN, the client PC, is doing the work.[13] Improving the throughput for all users requires upgrading all the PC's on the LAN.

A more radical alternative to adopting a client/server system is to outsource all or part of your system. The outsourcing that many IS managers are turning to for client/server help is more tactical. Outsourcers, such as Andersen Consulting of Chicago and Computer Sciences Corporation of El Segundo, CA are being called on to handle a segment or segments or IS' mundane work, like managing the help desk, managing the network, system administration or some other piece of the infrastructure. They are also providing expertise to help design and manage vertical applications. Occasionally, outsourcing contracts include a healthy dose of systems integration that actually gets new client/server systems built.

The big difference between mainframe outsourcing and client/server outsourcing is that IS is staying in the picture. Many times, the agreement is that the outsourcer will eventually hand it back over to the customer when their work is done. Another big difference between client/server outsourcing contracts and mainframe/data center pacts is that the outsourcer is not buying your data center. In most client/server contracts, IS maintains hardware responsibility, but outsourcers will refresh the technology at regular intervals to make sure that hardware and software stay current. Also, client/server contracts are rarely for more than five years, whereas typical data center deals are for ten years or more.[14]

As far as the demand for outsourcing services, Forrester Research, Inc. in Cambridge, MA estimates that data center outsourcing was a $10 billion business in 1993, and it's growing by 10% per year. Client/server outsourcing is a mere $2-$3 billion business in comparison, but it's growing at 40%-50% annually.[15]

CONCLUSION

Everything that has been discussed can not happen unless management is willing to completely back this change. A key to successful client/server implementation is the competency of management. The management of client/server computing is more complex than management of a mainframe environment; there are many more variables to consider, and many more risks to control. Pro-active management based on an understanding of the technical issues is necessary for success. Management must:

- have a keen understanding of exactly what their employer wants and expects to accomplish.

- realize that, in the new business computing environment, it is both irresponsible and suicidal to "bet the farm" on any technology which is not demonstrably reliable.

- not allow themselves to depend on vendor support.

- realize that modern computing networks are some of the most complex artifacts the human race has yet created.[16]

Given pro-active, astute management and judicious technical and application architectures, it's possible to build successful Client/Server systems.

NOTES

[1] Morris Edwards, "So You Think You Know About Client/Server," Communications News. April 1994 p. 55.

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[6] Schultheis and Bock, p. 13.

[7] Schultheis and Bock, pp. 14-15, 39-40.

[8] Jeff Moad, "Client/Server Costs: Don't Get Taken For a Ride," Datamation. February 15, 1994, p. 34.

[9] Moad, p. 35.

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A Model for Integrating Client/Server into the Undergraduate Curriculum

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Abstract

Problem solvers for the current information age need a knowledge of client/server systems. The natural integration of client/server systems into the current curriculum will give students the knowledge they require for competitiveness in today's market. By examining the client/server model from various approaches, students can develop an understanding of client/server systems. This paper describes a process to integrate client/server concepts into an undergraduate curriculum.

Introduction

As client/server technology becomes the prevalent model in today's computing environment, corporate America is prodding colleges to develop client/server courses[1]. The shift, from centralized computing and stand alone personal computers to client/server systems, needs to be reflected in the undergraduate curriculum, but how? Client/server concepts can be presented in a separate course or integrated into numerous courses. This paper defines a paradigm for the introduction of client/server concepts into the curriculum, through a natural process of integration.

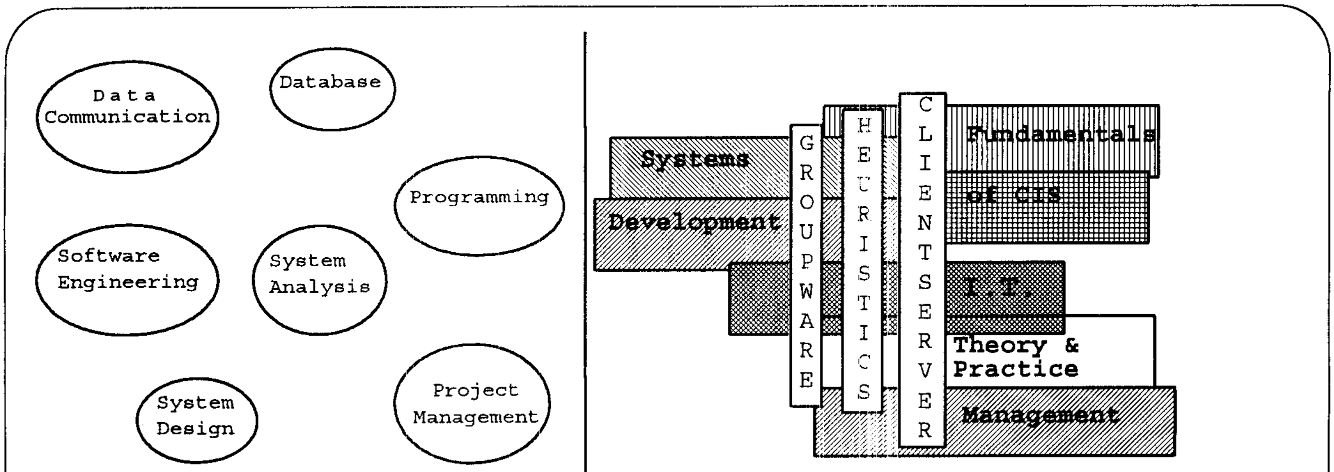
Client/server technology has evolved in order to meet rapid data access needs and end user demands. The evolutionary development is incomplete, though the direction towards open and distributed systems is becoming more apparent. Since a client/server system is not a single, well-defined system based on a well-defined model, the curriculum modules must be flexible enough to reflect continuing development of the model.

If the curriculum is viewed as an overlapping concept development process rather than a set of discrete modules, then client/server may be treated as a vertical bar cutting across the curriculum. Figure 1 shows the mapping of traditional courses as proposed in the DPMA 1991 Model[2] and by the ACM [3] into a more integrated structure with topics such as groupware and heuristics that cut across the curriculum, displayed as vertical bars. The right hand model includes the areas of core concepts as described in IS '95, a Model Curriculum for a bachelor's Degree in Information Systems[4].

This paper focuses on that client/server bar in the diagram, defining concepts that need to be covered, placing these concepts into the curriculum and discussing possible approaches to content coverage. Suggested tools for providing an integrated structure are given.

Client/Server Concepts

A working definition of client/server and the important aspects of client/server needs to be



Traditional Discrete Courses

IS '95 Curriculum Areas with cross discipline topics

FIGURE 1

derived first. For the purposes of this paper, any model divided into two parts, with the database located in one part, (the server) and the applications located in the other part, (the client) will be considered client/server. Simpler client/server architectures have a single server with multiple clients. This can be expanded to include multiple servers with individual or simultaneous access. Seamless data access is considered a distributed system by Date[5] though others allow multiple clients and multiple servers, even permitting a server to act as a client and a client to act as a server in some situations, and consider it a client/server system[6]. The broader definition, allowing multiple clients and multiple servers each permitted to play dual roles, will be adhered to throughout this paper.

In attempting to determine which particular concepts must be taught, the teaching objectives should be reviewed. Not all students will develop client/server systems, however, most students will use client/server systems and be responsible for the consistency and accuracy of the system's output. From this perspective the following concepts should be covered:

- Definition of client/server model, client/server system
- Network requirements for client/server system
- Designing GUI's for client/server systems
- Effects of a client/server model on data manage

- The goal is to design a process for the presentation of various aspects of client/server from different perspectives and as a unified system, within the framework of the current curriculum.ment
- Managing client/server systems
- Testing clent/server systems
- Maintaining security in a client/server system
- Effects of client/server model on conceptual design
-

Integrating Client/Server into the Current Course Structure

The proposed paradigm aims at the integration of client server concepts into a current course structure. The method is valuable since it allows students to approach the client/server model from various directions. Each course has its own perspective. It is through this lens that the model will be seen. The final interaction a student has with the client/server model should be in a system design or project course where all the various views are assimilated into a cohesive client/server system.

Prior to determining where to insert client/server modules, an overall view of the current curriculum, delineating the actual content of each course, should be undertaken. This can be achieved through content matrices or radar charts. An attempt is then made to insert the required client/server modules into the appropriate courses and the actual ideas to be covered in each module are determined. This might require a few iterations to achieve the best fit. A spiral approach, with the students revisiting the model from different directions is envisioned.

Considering the model's natural division into two parts applications and database, the first cut at placement is straight forward. The database issues are placed in the database course. This would include such issues as integrity, concurrency control, access, and data distribution. The application issues such as consistent user interface, application programs, report generation and query response are placed in introductory or programming courses. A finer breakdown becomes more apparent with the definition of the modules in the next section.

Teaching Modules

A different skill set is required for developing a client/server system than is required for , testing and maintaining the system. Schultheis details the breadth of skills and knowledge required to build a client/server system and the urgency of acquiring the capability[7]. Figure 2 gives an overview of topic perspectives relative to courses.

In an introductory course, students deal with some type of user interface. In many cases, first courses are PC based and use Windows and/or a graphical language such as Visual Basic or Visual C. The notion of the PC as a front end device, a client, or a user entry point into a client/server system should be presented. This module should be developed from the end user point of view and be of limited complexity. The definition of the client/server model should be developed and

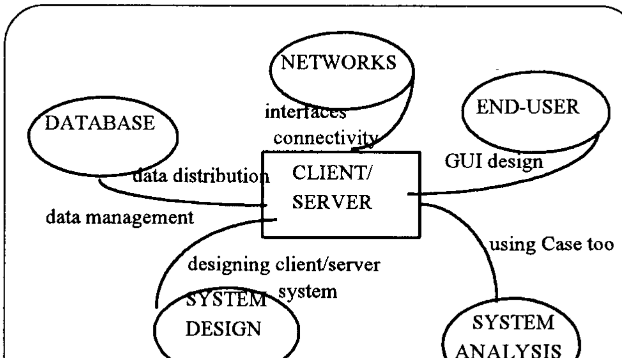


Figure 2
Different perspectives of Client/Server

means to access server files through the client should be demonstrated.

The client concepts are expanded in programming courses by including the writing of an application program which accesses one or more server files. This should not substantially increase the workload of the course but rather change the perspective of lessons on input data and files. Discussing file concepts in client/server terminology, data residing on servers and being accessed through application programs, expands the students perception of the model.

When analysis tools, such as CASE tools are introduced, their use in the client/server system should be mentioned. Students, exposed to the client/server model already, have a developing knowledge of what the system looks like. They need to understand exactly how CASE fits as an integrated piece in the system.

In System Analysis students need to acquire the ability to utilize specialized software to model the information systems part of the *socio-technical system*[8]. The client/server model, having evolved to meet end users' demand to access data from their Windows based PC, naturally fits into a socio-technical systems theory and design methodology. It includes both technical and social aspects of work systems.

A Data Communications course examines the communication of data in a computer based information system. The client/server model is a special case in which the flow of data needs to be examined. The particulars unique to the relationship of data in the client/server model is the perspective through which the model is examined in this module. Application Program Interfaces (API's), necessary for communication between heterogeneous client and server products, can be mentioned in the course. A module discussing the consequences of network configurations on data communication and the effect of non standard protocols for data calls can include client/server concerns such as the role of middleware.

The Database Management course should include a full unit to study the client/server model from the perspective of data management. The distribution of database functionality between client and server needs to be studied. If a project is included in the course, students should investigate the effect of expanding their project database to a client/server system. Students can determine the effect this model change has on their conceptual model, the security implications, necessary concurrency controls and the tasks which will reside on the client. Issues relevant to the distribution of data on multiple servers should be included.

Software Engineering should include a module on analysis and testing of client/server systems. Testing a client/server system is one of the challenges of this environment. Students at this level should realize the complexity of the system. They should learn how to break apart the system into it components parts and study the relationship between the parts. The weak points of the system should be examined in detail. The emphasis in Software Engineering is placed on how to evaluate, test, and maintain diverse systems containing components configured as clients and servers.

The Security course should examine the increased complexity inherent in the client server system and how it effects security. The unique security problems imposed by the model need to be studied.

A System Design project should consider the costs and benefits derived from designing the system using a client/server model. Even if a different model is chosen, the client/server model should be included in the selection process with elevation criteria determined.

Client/Server Tools

An integrated set of tools is required for consistency and organized concept development. A set of tools used throughout the curriculum eliminates the learning curve delay. Once student's learn a tool, they continue to use the tool, adding more tools as needed. The tool set is developed in a manner similar to a mechanic adding new tools to his work bench as needed. The tools can be used at different times, alone or in conjunction with other tools to meet varying ends.

Visual Basic is an example of a multi-purpose tool. Students can be taught Visual Basic in an introductory course as a Visual language. This tool can later be used in the design of GUI's for a client machine. Since students know how to develop applications using Visual Basic, they only need to expand their knowledge to include accessing data from a server. Since Visual Basic contains ODBC drivers, data can be accessed from various servers. Thus, through a familiar tool, students investigate queries and updates of data on remote servers.

Tools designed to facilitate systems development are appropriate for the client/server model. For example, CASE tools provide a method for capturing , manipulating and reporting on the requirements and design specifications of a project. Through decomposition models and data dictionary facilities, CASE tools provide useful conceptual models. The CASE tool used for System Analysis should be referenced in the database course, or, ideally, used for database projects.

A modeling tool such as Visible Analyst can be introduced in System Analysis then used again in Database Design, System Design or Projects courses. Once a model is established in Visible Analyst, the effect of implementing it in a client/server environment can be considered.

Conclusion

Client/server concepts can be integrated into the current curriculum without major curriculum revision. By designing a four year developmental approach to teaching the concepts, no one course will be overly burdened. The time needed for inclusion of this extra topic can be found by examining the current courses for overlapping topics. The consolidation or removal of overlap can free the extra time needed to include the client/server modules.

Though the client/server concepts are presented from multiple directions, the goal is to allow students to view the whole system as an integrated information system. The client/server model is used across all levels of information systems and should be included in all levels of the curriculum.

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Process Education: The Third Leg of Software Education

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Abstract

The quality, schedule and cost of a software product are largely governed by three determinants: technology, process, and people. Technology is the methods, techniques and tools used to create software. Process is the set of activities, methods, practices, and transformations used to develop and maintain software and associated products. People are the agents utilizing the technology based on a process to create software. Like a three-pronged stool, each leg is equally important. Yet, while technology has been well defined, and people are technology conversant, the process leg has not been considered as important. However, the increased complexity of software and the demand for quality software has underscored the need for process. To educate future software professionals, it is now essential to devise software education curricula that combine technology and process education. In this paper, we describe how process education is interwoven with a Software Engineering curriculum and describe a set of courses aimed at providing this education.

INTRODUCTION

Traditionally, there has been conflict between industry and academia views of software education. Industry complains that universities have not been responsive to the educational needs of the software industry; they argue that American universities are turning out students with little practical training applicable to the real world of software code writing. More than half of the companies recently surveyed [5] reported problems including a faculty culture unreceptive to business and a lack of interest on the part of academicians in designing programs and resources for industry. Universities respond that industry is unable to adequately define the knowledge and skills required of software professionals. Yet, industry's old notion of employing super programmers or deploying the latest technology as the solution to the software problem has proved woefully inadequate.

The answer to this dilemma is the realization of the need for a disciplined process for people to use when employing technology to create software. Technology is defined as the collection of methods, techniques, and tools used to create software; it encompasses analysis, design and coding methods, CASE tools, and the development environment. Structured techniques, object oriented methodologies, Windows® and UNIX® are examples of technology in this context.

Process is defined as the procedures, methods, tools, and equipment used to transform raw material (input) into a product (output) that is of value to customers. A software process is a set of activities, methods, practices, and transformations used to develop and maintain software and the associated products.

People are the agents utilizing the technology based on a process to create software. Yet people often accept any new technology which promises an improved product as evidenced by the large number of organizations which purchased and attempted to use CASE tools when they first became available. They have too often relied on technology to the detriment of proper attention to process. They are yet to be convinced of the crticial role that process plays in the improvement of the quality of software. The one lesson that should be learned from the often abortive use of CASE tools is that improved technology does not necessarily lead to an improved product. People need to appreciate the importance of process linked to technology and then become educated and trained in both in order to produce quality software on time and within budget.

The answer, therefore, to the software quality dilemma lies in the third leg of the three pronged stool -- a disciplined process to use the technology and guide the people throughout the development cycle; without a strong third leg, the stool will not stand. In industry, the software process assessments conducted by the Software Engineering Institute (SEI) have shown that both the quality and the productivity of software projects increased in organizations that adhere to defined processes [1]. Adherence to disciplined and defined processes has proven to be as important as the deployment of effective technologies, and employment of capable people. There is an increased realization by software organizations that the quality of a software product is a direct reflection of the quality of the process that created it.

TECHNOLOGY TRANSFER

Most new ideas for advancement of software development have come primarily from industrial pioneers. For example, advancement of software development methodologies (structured, as well as object-oriented techniques) is credited to Ed Yourdon, Tom Demarco, Larry Constantine, Grady Booch, James Rumbaugh and Peter Coad -- all members of industry. Relational Database technology is attributed to the pioneering efforts of Ted Codd, also a member of the software industry. As with advances in technology, new ideas for advancing software have also come from industry. Software inspection and process modeling, for example, are attributed to the works of Michael Fagan and Watts Humphrey, neither of whom originated in academia.

Technology transfer of knowledge, that is training and education about new ideas, takes place in four ways -- vendors, consulting firms, in-house courses and academics. The challenge to academics is to transfer new technologies into curricula and laboratories in a timely manner; that is, to reduce the length of time it takes to modify curricula, produce textbooks, and prepare faculty in order to introduce new technology into the learning process so students can be current. For example, whereas Structured Analysis and Structured Design were developed in the 1970s, roughly 15 years passed before there were textbooks on the subject and the techniques became a standard part of the curricula. Increased demand for software used for everything from computers to cars, stereos, watches, and even electric shavers has necessitated shorter cycle times for software development. Academics, therefore, is having to adopt new approaches far more rapidly than in the past in order to keep its graduates marketable.

AN INSTANTIATION OF PROCESS EDUCATION

Integration of process education into software curricula is still in the early stages having originated in industry primarily through the efforts of the SEI. The curriculum described in this paper is an instant of an effort to bring software process education into the academic curriculum in a more timely manner. The curriculum is a result of collaboration between industry, Embry-Riddle Aeronautical University and the Software Engineering Institute. The Master of Software Engineering (MSE) program is in part based on the SEI model [2], with an added process component. The approach taken intends to integrate process education with technology education. Since technology, process, and people are the three determinants of the quality, schedule and cost of a software product, it is then natural to devise software curricula that combines technology and process education.

The MSE curriculum is divided into a set of core courses, two focus areas, a set of elective courses and a practicum. The curriculum addresses major elements of the software development process including project management, requirements engineering, system design, implementation, verification, validation, and maintenance. Special emphasis is given to real-time embedded software systems encountered in such applications as the FAA Advanced Automation System, aircraft avionics, and that being developed for the proposed Space Station Alpha, among others.

In this paper, we describe only the process focus of the curriculum. The first course in the core course sequence is based on Watt Humphrey's Personal Software Process (PSP)[3] . The PSP is a paradigm devised to teach software engineers how to use process concepts in their individual work.

THE PERSONAL SOFTWARE PROCESS

The Personal Software Process (PSP) is a process-based method that software engineers can use to apply software engineering principles to their work. The PSP methodology provides a software engineer with a defined personal process framework. The framework enables engineers to use metrics to track and evaluate performance in order to meet quality standards and improvement goals. The framework requires the engineer to develop a personal project plan, record development time, track defects, and retain this data in a project summary report. The data is then used to analyze and evolve personal processes, and to plan future projects. The project plan includes a documented size estimate and a statistically derived size prediction interval as well as a defect estimate. The quality strategy used with the PSP is consistent with that practiced by many hardware organizations: build quality into the product from the start.

The PSP paradigm, although equally applicable to teams and large-scale projects, focuses on individual software practitioners who need a framework for defining and improving their personal software development process. It is based on the principle of data-driven process improvement whereby measurements and statistical techniques are used to help software engineers understand their own skills, to highlight process deficiencies and to provide a focus for process improvement. By providing a viable framework for gathering data, PSP helps individuals to develop a quantitative understanding of their process steps. It further demonstrates how process methods can effectively be used to improve product quality and increase productivity. It does so by guiding the individual through an evolutionary path from simple process concepts, such as project planning, to advanced levels of process maturity, such as defect prevention.

PSP bases its software improvement process on the use of sound engineering principles and techniques. For example, regression analysis is used to correlate program size and effort data for projecting resources and scheduling for a new task; Parieto analysis is used to analyze defect distribution; process control charts are used to demonstrate process stability, especially for review processes (e.g., code and design reviews and design inspection). PSP measures the effectiveness of review and inspection processes, and hence determines the cost of quality through rigorous mathematical treatment of process yields.

The PSP course introduces students to the fundamental principles and methodologies of software engineering. It presents the cost and benefit of a Personal Software Process (PSP). It provides a framework for a statistically managed software engineering discipline. Students gain experience in developing software engineering skills.

The intent of the process focus is to provide an in-depth coverage of process related concepts and prepare students to take an active role in process improvement initiatives in their future organizations. The process focus consists of three courses; Software Process Definition and Modeling, Software Process Improvement, and Metrics and Statistical Methods for Software Engineering .

Software Process Definition & Modeling course provides students with the fundamental knowledge for software process definition and modeling. Software process context which include a framework for process definition and modeling, engineering of processes, enactment of the processes, and description of the process properties are covered. Process definition topics such as Process, Process Step, Process Element, Process Script and various process modeling representations such as text- based, template-based, graphical based to include State Transition Diagrams (STD), Entry-Task-Validation-Exit (ETVX), Statecharts and Petri-Nets, as well as automated tools for process representations are covered.

The Software Process Improvement course is intended to provide students with fundamental knowledge of process improvement issues. Subjects covered include software process maturity, software process models and standards (i.e., CMM, ISO), and improvement approaches at organizational, project and individual levels are studied. In addition, concepts for quantitative software process managment and their origins are emphasized and process improvement initiatives for defect detection (e.g., inspection) and defect prevention (e.g., casual-analysis) are studied. Topics which relate to process improvement, such as risk management, organizational culture, group dynamics, and technology change management are also covered.

Metrics and Statistical Methods for Software Engineering course is concerned with three related topics of software measurement, statistical tools and methods, and applied experimental design in software engineering. Students will be introduced to the principles and concepts relevant to measurement in software engineering; including the representational theory of measurement, collection, analysis and validation of data. Also studied are frameworks, such as Goal-Question-Metrics and Quality Function Deployment paradigms, for guiding measurement efforts. Statistical methods, along with Statistical Process Control (SPC) tools such as Control Charts, Fishbon Diagram, Scatter Diagrams and advanced subjects such as Taguchi's Robust Design technique and their application in software engineering are covered. Also explored are the concepts of experimental design, analysis of experiments, model building, ethics and presentation of experiments.

SUMMARY

With the increased importance of quality software and the rapid growth of demand, academic institutions need to take a more proactive role of providing the software education needed by industry. There is a need for industry and academia to cooperated in order to transfer new knowledge into the curricula, thus enhancing the advancement of the field. As the software industry looks towards process improvement as a means to software quality improvement, it is increasingly important that process education be incorporated into software curricula in order to adequately address their needs. The Embry-Riddle courses offered in the area of process provide one example of the type of curriculum that will prepare the software professional for the inevitable changes in the software industry.

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Organizational and End-user Information Systems
The Office Systems Research Association Model Curriculum for Undergraduate Education

Panel Session

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The Office Systems Research Association's four-year model curriculum (1996) in organizational and end-user information systems (OEIS) underscores the notion that information systems at the desktop level are crucial to support organizational goals as well as bolster and sustain individual employees' needs to do their jobs well and grow in their careers. It is intended to bring the impact of high-level talk about business reengineering to the practical level of implementation, where it counts the most.

The 1996 model curriculum, an update of OSRA's 1986 Model Curriculum, breaks new ground by emphasizing the technical aspects of multimedia desktop information systems along with organizational and individual factors that are vital to the success of any new system. This panel of representatives from the 1996 OSRA Curriculum Revision Group will provide an overview of the four-year curriculum, including its development and individual courses. Questions and reactions from attendees will be encouraged. Stressing that a model curriculum must be flexible, courses and their titles are meant only to provide casings for competencies and instructional modules. The curriculum model itself is presented in a framework of modules within semester courses. A complete copy of the curriculum will be made available to those attending.

General Education Core plus College of Business Professional Core
OEIS Core Courses: OEIS Concepts; End-user Technology Solutions; OEIS Planning and Design; OEIS Implementation and Evaluation; Designing and Managing Organizational Training; Communications Technologies; Cases in OEIS
OEIS Optional Courses: Information and Media Management; Special Topics; Business Process Redesign; Internship

A Comparative Study of MIS Education in USA and the People's Republic of China

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ABSTRACT

This paper compares eight aspects related to the syllabus and teaching of Management (Accounting) Information Systems programs at Hangzhou Institute of Electronics Engineering (HIEE) in the Peoples Republic of China and Southeast Missouri State University in USA. The authors analyze the possible reasons for the differences and make some suggestions to improve the Chinese MIS/AIS education.

INTRODUCTION

The People's Republic of China (hereafter, PRC) started to introduce MIS classes in their schools only in the early eighties after the cultural revolution. Most probably the earliest MIS program was implemented at the People's University of China in Beijing in 1978 (Ho, 1989). There are at present more than 400 institutions in China who have introduced MIS/AIS curriculum.

Out of the few articles published in this topic in the US two notables ones are about the Management Education and training strategies in PRC (Wagner, 1992) and the Development of MIS education in the PRC (HO, 1989). We took this study to compare the MIS/AIS education in Hangzhou Institute of Electronics Engineering (hereafter, HIEE) and Southeast Missouri State University (hereafter SEMO). One of the authors is a faculty and familiar with the MIS/AIS education in HIEE. He is at present in Southeast Missouri State University as a visiting scholar and this provided us an opportunity to exchange ideas and compare notes. HIEE is a University which is a middle level teaching Institution of Higher Learning, which we consider as a representative of the vast majority of institutions of higher learning in China. Business and accounting degrees are awarded. Southeast Missouri State University is a regional state institution with about 7,925 students in 1995-1996 and 371 faculty. The number of declared business majors are about 1000. The SEMO business school is a candidate for AACSB accreditation. The student body at HIEE is around 3400 and there are about 400 faculty there. The institutions are comparable for our purpose. Table I provides some facts about both the institutions.

THE METHODOLOGY

We chose seven areas for this study: 1. curriculum and contact hours, 2. pre-requisites, 3. teaching objectives, 4. course contents, 5. computer expertise and labs, 6. text books, 7. orientation and study situation.

1. Curriculum and Contact Hours: (Table 2)
SEMO follows the semester system. All the business students take a 3-credit hour computer usage course in their first year. This course teaches them DOS, spread-sheet use (now it is LOTUS 1-2-3), and word processing (WordPerfect). The MIS course is taken by both Management majors and Accounting Majors. It is a prerequisite for the Accounting Information Systems course taken by the accounting majors. The students taking the first introductory MIS course are expected to spend three hours in class per week and devote at least three to four times the contact hours outside of the class to the subject matter. There are three or four examinations including the final during the semester.

There are computer lab sessions where the students are given on-hand training to use the different computer packages in the MIS context. They are given regular computer assignments to be done and to be submitted for grading. The labs are open from 7:30 am to 11:00 pm all days of the week. The labs are equipped with 80486 computers with windows software and laser printers. In addition to developing information systems using word processing, spread sheet, database packages, the students also do exercises in Expert systems using LEVEL5 software. The course is geared to business orientation and to help the future managers blend technology in all their decision making processes.

At HIEE, there are two streams for information systems education. Two departments (management and accounting) offer courses in information systems. Please see Table 2 and Table 3.

2. Prerequisites

At Southeast, the students are required to be juniors (must have completed 60 college credit hours) and must have taken the College Algebra, Applied Calculus, Business Statistics and at least a first introductory courses in Management and a course on computer usage introducing the students to DOS. WordPerfect, LOTUS 1-2-3, and dBASE IV.

At HIEE, the students in the management department take Advanced algebra, Linear algebra, Foundations of computer, Operations research and Foxbase (which is database management software very similar to dBASE) and then branch off to take either one Management Information systems or take two courses, one in Data Structure & Data Base and another, Decision Support Systems. Students in Accounting department take Advanced algebra, Introduction to Probability and Statistics, Foundations of Computer, Microcomputer Data Base, Accounting Information Systems, and Computer Aid Financial Management. Please see tables 3a and 3b.

3. Teaching objectives (Tables 4 & 5)

Southeast students should have developed the following skills and expertise after they have completed the course.

1. Understand the five components of Personal Information Systems, Work group information systems and executive information systems
2. Develop a prototype personal information system
3. Blend technology with business and identify potential applications of technology and cause their development
4. Be knowledgeable about Decision Support Systems and Expert Systems
5. Able to appreciate the all pervading role of information systems in a manager's everyday life and decision making

4. Course contents:

The following topics are usually covered at Southeast.

Introduction to Management Information Systems
Fundamental Types of Management Information Systems
A brief introduction to Information Systems Technology
Personal Information Systems: Applications and Goals, Components, and
Developing Personal Information Systems and Database Applications
Applications and Goals of Workgroup Information Systems, Components, and Developing Workgroup Systems
Components, Application & Goals and Development of Enterprise level Management Information Systems
Decision Support Systems and Expert Systems - an introduction
Use of Wordprocessing, spreadsheets, data base management systems and expert system software

5. Computer Lab work & computer time

Southeast students are given on-hand training in the use of 486 Computers to develop elementary prototype information systems. They are encouraged to acquire their own computers but it is not mandatory. There are computer labs throughout the campus accessible to all the students throughout the weeks. The labs are open for at least for 90 to 110 hours per week and are supervised by trained student workers. There is also a full time coordinator for all the labs and the machines are maintained by the computer center personnel. All the lab computers on the campus are networked with a fiber-optic backbone. The students are provided with access to Internet and Gopher and they are given some assignments. The present trend is to train the students in the windows environment.

6. Text Books

The current text book is "Management Information Systems, Third Edition" by David Kroenke and Richard Hatch and published by Mitchell McGraw-Hill. Usually the complete text book is covered in the course. The text book is rented by the student for $12 per semester from the University's book rental system. In addition the students are required to buy a lab book, "Learning to Use Microcomputer Application," by Shelly and Cashman, and published by Boyd-Fraser. The text book for the Accounting Information Systems is: Accounting Information Systems, Sixth edition, 1994, by Barry E. Cushing and Marshall B. Romney, and published by Addison-Wesley Publishing Company.

The textbooks followed at HIEE are: 1. Computer

Applications in Financial Management, 1990, by Li Xiang-Guo (in Chinese). 2. Decision Support Systems, 1992, by Chao Lai-Chun (in Chinese), 3. Analysis and Design for Information Systems, 1989, by Cao Jin-Fang (in Chinese), and 4. Computer Accounting Information Systems-Frame work and Technology, 1990, by Yuan Rong-Fang.

7. Orientation

The course orientation at Southeast is towards business applications and decision making. The blend of technology with business is the criterion of teaching. The primary goal is to blend the fluid and ambiguous business organization and management with the precise, rigid and concrete technology. The emphasis is to put business before technology. The students are given guidance to develop skills to deal with unavoidable ambiguity of the modern day management in a highly competitive market place.

The course orientation at HIEE is towards technical applications of the computer including programming, computer languages and computer tools rather than business application. This may be due to the fact that the modern management/business concept is yet to be integrated in to the curriculum and most of the teachers teaching information systems are computer scientists.

ANALYSIS

From the above discussion the following are apparent. The teaching objectives and the contents are different. The orientations are also different. The lack of computer facilities in China can be explained by a developing economy. The policies practiced by the previous governments have contributed to the current state of the MIS education in China. Most of the teachers are not MIS/AIS graduates. The Ph.D. granting institutions are only of very recent origin. Nearly all the MIS/AIS teachers are computer scientists or engineers. The orientation is toward technology and not business. Too much emphasis is given to computer programming and design. Most of the managers in industry or corporations do not give any importance to information systems or even the use of computers, a situation existed in US a few decades ago when the labor unions vehemently objected to the introduction of computers.

CONCLUSIONS

We can summarize the situation as following:
1. The total time devoted to MIS/AIS course time in HIEE is more than that in SEMO, and the prerequisites include lot of computer programming in HIEE.

2. The technology to develop MIS/AIS is stressed in China whereas in USA, application is stressed, namely, to solve the problems and decision making with MIS/AIS.

3. The Chinese students are provided limited number of computer hours to do the computer assignments. There is severe paucity of MIS/AIS software in China;

4. The Chinese students are at a disadvantage compared to American students in the ability to solve problems with MIS/AIS knowledge.

5. Most of Universities in China have poor application software related to MIS/AIS. Either MIS/AIS software have not been provided or their prices are very expensive on Chinese market. Most factories and companies have very limited number of microcomputers or MIS/AIS software.

Recommendations

On the basis of above analysis, the authors suggest the following for the improvement of MIS/AIS educations in academic institutions in China, which may be appropriate for similar developing countries also.

1.The principal objective of MIS/AIS education should be to train students to develop problem solving decision making skills using MIS/AIS. The objective should be to learn how to participate as a user and not to design or programming during developing a MIS/AIS. In view of this, the syllabus and textbooks related MIS/AIS programs in HIEE may be required to be changed.

2.The computer software companies in China should devote major efforts to develop a variety of MIS/AIS software, which are suitable to Chinese business and enterprises. The government must subsidize these efforts. The price of these MIS/AIS software should be economical and the quality be excellent. We also suggest that the computer software companies of the industrially developed nations should develop MIS/AIS software in cooperation with the computer software companies of China. They should recognize that China's potential as a huge market for computer software.

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Table 1

Number of Faculty, students, etc. at HIEE and SEMO :

	HIEE		SEMO	
	Dept. Of Management	Dept. Of Accounting	Dept. of Management	Dept. Of Accounting
Faculty	40	50	10	12
Students taking MIS/AIS courses	646	900	1000	400
Learning Years in University	4	4	4	4
Number of Faculty Teaching IS	2	2	2	2
Area of specialization of Faculty Teaching IS	Engineering Science	Computer Science	MIS/POM	Accounting

Table 2

Department of Management				Department of Accounting			
HIEE		SEMO		HIEE		SEMO	
Course	contact hours	Course	contact hours	Course	contact hours	Course	contact hours
DSS	51			CAFM	51	MIS	48
MIS	51	MIS	48	AIS	68	AIS	48

Explanation:

1) CAFM is abbreviation of Computer Aids Financial Management.

Table 3a.

HIEE

Department of Management

MIS DSS

Data Structure and DB

Foxbase + OR

Foundations of computer

Linear Algebra

Advanced Maths

Department of Accounting

Computer Aid Financial Management

Accounting Information Systems

Accounting IS

Microcomputer DB

Foundation of Computer

Intro. to Probability & Statistics

Advanced Maths

Table 3b.
SEMO

Department of Management	Department of Accounting
Information Systems (II)	Accounting Information Systems

Information Systems (I)
Management & Organization
Introduction to Microcomputer
College Algebra
Keyboarding and basic Applications
Intermediate Algebra

Table 4
Department of Management

University	Course	Objective
HIEE	DSS	A. understand the basic framework of DSS of a enterprise; B. to hold the design approach of ROMC, MB and MBMS.
	MIS	Understand the whole procedure to develop MIS, the system analysis and system design are stressed.
SEMO	IS(I) IS(II)	A. understand the components and types of computer-based information systems; B. describe the role of information systems in decision making; C. again hands-on experience on the use of several selected MS DOS (Microsoft Disk Operating Systems) commands; D. learn to solve problems using the most readily available "off the shelf" general application software (Lotus 1-2-3, dBASE IV); E. use management support tools such as decision support systems (DSS) and ES; and F. demonstrate awareness of the ethical and global issues in information systems.

Table 5

Department of Accounting

University	Course	Objective
HIEE	CAFM	provide a general understanding of CAFM based on AIS
	AIS	A. understand the components, framework and developing procedures of AIS B. hold one of developing approaches of IS
SEMO	AIS	provide a general understanding of accounting information systems. As a result of successfully completing this course a student should be prepared to develop accounting information systems, use various software packages, and have a general awareness of the types of accounting related software on the market.
	MIS	See Table 4

Table 6
Department of Management

University	Course	Textbook	Content
HIEE	MIS	Management Information Systems	1) Feasibility Analysis of Systems; 2) systems analysis; 3) systems design; 4) systems implementation, operation and valuation; 5) developing orientation of MIS
	DSS	Decision Support Systems	1) Basic concept of DSS; 2) The architecture of DSS; 3) Model representation and model base organization; 4) Dialogue management system; 5) DSS systems analysis and design; 6) operation on computer and practice
SEMO	MIS (I)	Management Information Systems	- Introduction to management Information Systems - Fundamental Types of Management Information Systems - Introduction to Information Systems Technology - The Value Added by information Systems - Personnel Information systems: Applications and Goals - Components of personnel Information Systems - Developing Personnel Information Systems - Workgroup Information Systems: Applications and Goals - Components of Workgroup Information Systems - Developing Workgroup Information Systems - Enterprise Information Systems: Applications and Goals - Components of Enterprise Information Systems - Developing Enterprise Information Systems - Improving Decisions with Decision Support Systems - Improving the Use of Knowledge: Knowledge Systems

Table 7
Department of Accounting

University	Course	Textbook	Content
HIEE	CAFM	Computer Aid Financial Management	1) development approach for financial management systems; 2) development and applications for management module of fixed funds; 3) development and applications for management module of dynamic funds; 4) development and applications for management module of cost; 5) development and applications for management module of sale and profit; 6) development and applications for management module of financial income and expenses; 7) financial decision support systems
	AIS	Accounting Information Systems	1) development technology for IS; 2) functional framework for accounting systems; 3) logical framework for accounting systems; 4) physical architecture for AIS; 5) systems safety and secrecy technology
SEMO	AIS	Accounting Information Systems	1) conceptual foundation systems: an overview; 2) the technology of information systems; 3) the systems development process; 4) control and audit of accounting information systems; 5) accounting information systems applications
	MIS (I)	Management Information Systems	see table 6

Table 8
Computer and Computers usage Hours

	HIEE		SEMO	
	Dept. Of Management	Dept. Of Accounting	Dept. Of Management	Dept. Of Accounting
number of computers	45	40	>100	>100
hours provided for each student	15 to 60	15 to 20	unlimited	unlimited
software in computer lab	MS-DOS Foxbase C Language	MS-DOS Foxbase	MS-Dos WordPerfect 5.1 Lotus 1-2-3 dBASE IV Level 5 Expert System	MS-DOS Lotus 1-2-3 Excel dBASE IV Microsoft Works Quicken/Quick Books Harvard Graphics Peachtree Accounting

Coming to Terms With the Communications Gap Between Managers and IS Professionals

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ABSTRACT

Vocabulary differences appearing in widely-read practitioner journals are systematically examined and an approach is offered which might serve as a practical starting point for reducing what seems to be an intractable communications gap between managers and IS professionals.

DEFINING THE PROBLEM

In their book dealing with issues facing senior executives, Cash, McFarlan, and McKenney [6] zero in early on a communication problem that persists between the information specialists and the users of their service: "Very often these specialist departments with their specialized vocabularies have created strained relationships with the users of their service. This has been an enduring headache from the start of IT." That statement strikes a resonant chord for most managers and information systems professionals who have been involved in IS development activities. Despite the awareness of the problem, however, there seems to be little movement toward resolving it. [1]

Raymond McLeod, Jr. also notes the problem in his widely-used textbook [3] on management information systems, and goes on to prescribe end-user applications development as part of the remedy needed to narrow the communications gap.

End-user development requires an end-user who is both "willing" and "able" to absorb some of the knowledge which is currently the domain of the information specialist. That takes learning time and it is often the case that the student's job requirements will not allow the necessary time for developing systems of any complexity. Furthermore, many information requirements call for a system which crosses functional boundaries - that's usually the case in a database environment. Such interdepartmental applications require more than one IS-knowledgeable end-user to achieve successful interfacing. Thus, the "willing" condition becomes essential to the success of a project. And, since the *raison d'etre* for interdepartmental systems is to contribute to the attainment of the firm's objectives, top management would soon recognize the need to manage the not-so-subtle reallocation of resources to systems development activities.

But, there's another approach to improving communications between the managers and IS professionals which takes aim at the root of the problem as McLeod sees it: "The [information specialist and the end user] speak different languages." [McLeod, p. 59] By improving their understanding of one another's language, the information specialist and the end user will improve their communication with each other and, in all likelihood, move to a new level of effectiveness in team-oriented IS development activities.

So, what does one need to learn about another's language in order to improve communication? Cash, et. al., [6] provide two lists of references: one for the general manager on information technology, and one for the information specialist on management. These lists provide some direction for background reading if you have a lot of study time available. Another contribution appeared recently in the form of the *Field Guide to Business Terms* published by the Harvard Business School Press. [7] The 288-page guide presents some 600 "essential business terms and concepts." Still other possible aids exist in the form of dictionaries of several thousand business terms and computer terms. The question remains: which terms are we most likely to encounter as we read management and information systems publications?

AN EXPERIMENT

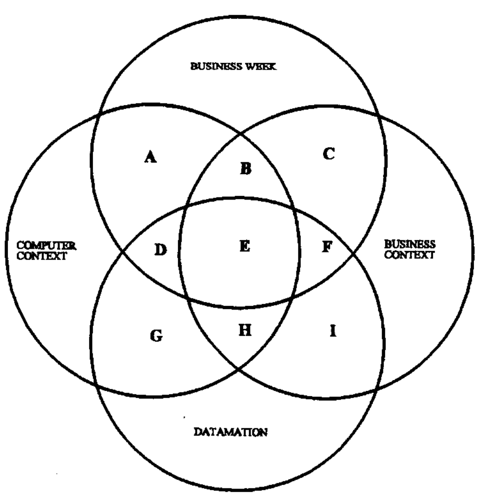
In an effort to answer that question, an experiment was conducted which involved the analysis of the use business jargon and information systems jargon in ***Business Week***, which targets business managers, and in ***Datamation*** which targets information systems professionals. The objectives of the analysis were first, to determine the extent of *common* usage between the two publications and second, to isolate the usage which is *unique* to each publication. Common usage reflects a measure of understanding between the two communities, while unique usage suggests a starting point for improving that understanding.

Twenty-four issues each of ***Business Week*** and ***Datamation*** were used as a source of text for the study. Columns of text were randomly selected from each issue and scanned electronically into a data base. The resulting *sets* of words were roughly equivalent to 350 typed, double-spaced manuscript pages for each publication.

The aggregated text for each publication was analyzed by computer to determine the density of "business terms" and "computer terms". Two dictionaries of terms were used to define the boundaries of the two contexts analyzed: first, a set of 6,000 business terms [4]; and second, a set of 4,500 computer terms [5].

Figure 1

Set Relationships Among Terms From Sample Text and Dictionaries



The Venn diagram in Figure 1 shows the relationships among the sets of terms found in the two publications, and the terms found in the two dictionaries which define the contexts of interest. The intersections of the four circles represent the subsets of terms, labeled A through I, which will be discussed throughout the rest of this article.

Each of the sample sets of terms was filtered through each set of dictionary terms, resulting in four sets of terms by publication and context. For example, the ***Business Week*** text was examined for the presence of terms which appear in the business terms dictionary. That subset of terms appears in Figure 1 as the area B+C+E+F. Examining the ***Datamation*** text with the computer terms dictionary produced the subset shown in Figure 1 as the area D+E+G+H. List 1 displays the ten most frequently occurring terms by publication and context.

List 1

Most Frequently Occurring Terms in Raw Data by Publication and Context

Business Week		Datamation	
Business Context	**Computer Context**	**Business Context**	**Computer Context**
Company	Up	Data	Data
Market	Get	System	System
President	Cut	Software	Software
Over	More than	Company	Computer
Business	Bank	Computer	Up
Rate	Down	Line	Network
Industry	System	Management	User
Money	Union	Business	Line
Long	Line	Market	Support
Tax	Software	Development	Technology

For each publication, the sets of computer terms and business terms found in the sample text were merged and examined for jointly occurring terms - i.e., those terms which were common to both dictionaries. (There were 411 possible common terms in the dictionaries selected for the study.) In Figure 1, the common terms in ***Business Week*** are included in the subset represented by the area B+E, and the common terms in ***Datamation*** are represented by the area H+E. Since it was not practical to partition these terms (B+E+H) by the intended context, they were eliminated from further consideration in order to reduce ambiguity.

Four subsets in Figure 1, A+D, C+F, D+G, and F+I, each consist of terms which appear in one dictionary or the other but not both. Areas D and F represent those terms which are unique to a context and common to both publications. Because they appear in both publications, it seems reasonable to assume that those terms are understood by both IS and management professionals. As such, they may be an indicator of the state of common understanding between the two communities. List 2 displays the top ten common terms by frequency and publication in each of the two sets:

List 2

Most Frequent Jointly Occurring Terms in Context Sets by Publication

Business Context		Computer Context	
Business Week	**Datamation**	**Business Week**	**Datamation**
Company	Company	Up	Up
Business	Management	Get	Get
Take	Business	More than	More than
Service	Development	Home	Find
Management	Service	Help	Move
Research	Take	Put	Help
Right	Research	State	Put
Change	Customer	Move	State
Strategy	Department	Find	Force
Insurance	Organization	Force	Flow

At this point, it's possible to isolate all terms by context which appear in one publication or the other, but not both, and partition them by publication. That is, we have reduced the sample text down to two sets of terms for each publication: those found in a publication which reflect the publication's primary context - i.e., business terms found only in ***Business Week*** (area C in Figure 1), and computer terms found only in ***Datamation*** (area G in Figure 1); and those found in a publication which reflect the primary context of the other publication - i.e., business terms found only in ***Datamation*** (area I in Figure 1), and computer terms found only in ***Business Week*** (area A in Figure 1).

It's probably fair to assume that business professionals will understand the business terms found only in ***Datamation***, and that IS professionals will understand the computer terms found only in ***Business Week***, so they, too, may reflect the state of common understanding between the two groups. List 3 lists the top ten terms by publication that appear in the opposite context.

The other two sets represent terms which are unique to their publication and context - that is, business terms which appear only in ***Business Week*** and computer terms which appear only in ***Datamation***. As such, those two sets represent starting points for each community in its effort to learn about the other's language. List 4 shows the top one hundred terms by frequency found in each of the two sets. (subsets of terms represented by areas C and G in Figure 1).

CONCLUSIONS

An analysis of the jargon used in two widely-circulated practitioner journals identified possible indicators of the levels of understanding and difference between managers and IS professionals. The value of the analysis depends on two implicit assumptions: first, that the terms used in the selected dictionaries are good reflections of the contexts being examined; and second, that the selected journals reflect significant proportions of the world views of their respective communities.

At each step in the process of reducing the text to List 4, there was some fuzziness in the context for many of the terms found. In List 3, terms like *formula*, *seed*, and *sample* could easily belong to another context. However, since each term appears in only one of the context-defining dictionaries, if any ambiguity exists, it exists with respect to contexts other than those specified by the two dictionaries selected for the study. Fortunately, each of the transformations made in the process of reaching the final sets had the nice quality of reducing ambiguity with respect to the chosen dictionaries, so the final sets are fairly clear as to context.

Of course the specific sets of terms in List 4 are not "magic bullets" for solving all, or even many, communications problems. In the author's view, however, the approach used to specify them may serve as a possible contributing remedy for bridging the communications gap. If you subscribe to the Sapir-Whorf hypothesis [2], which essentially states that our world view is determined by our language, then you'll agree that improving language skills - e.g., vocabulary - tends to broaden one's world view, and thereby, improves one's ability to generate viable alternatives in a problem-solving setting.

Finally, the practical task of finding an effective entry point into the jargon maze and an efficient path through it is problematic. The systematic analysis described above yielded for each context a set of terms numbering roughly one-tenth or fewer of the terms in the defining context, and numbering fewer than half of the context-related terms found in the sample text. With so much of the gravel removed by the filtering process, perhaps we have exposed at least a few nuggets of core knowledge for the motivated communicator to ponder.

List 3

Most Frequently Occurring Terms by Opposite Context by Publication

Business Week		Datamation	
Computer Terms	**f**	**Business Terms**	**f**
Housing	34	DBA	10
Formula	6	Express	10
Magnitude	6	Product Line	10
Microfiche	6	Presentation	7
Seed	6	Sample	7
Bundle	4	Recording	5
Crunch	4	Turnkey	5
Inputting	4	Battery	4
Rank	4	Composition	4
Brush	3	Consolidation	4

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[6] Cash, J., F. McFarlan, and J. McKenney, *Corporate Information Systems Management*, 3rd Edition, Richard D. Irwin, 1992.

[7] *Field Guide to Business Terms*, Harvard Business School Press, 1993.

List 4

Top 100 Terms by Publication and Primary Context

(Note: Frequencies appear in parentheses)

Business Terms Found in *Business Week* Only		Computer Terms Found in *Datamation* Only	
DEBT (44)	MARKET VALUE (4)	UNIX (68)	MOTOROLA (7)
FED (27)	MONETARY POLICY (4)	PROCESSOR (62)	NCC (7)
MONETARY (22)	NOTICE (4)	COMPUTING (41)	OFFICE AUTOMATION (7)
DEFICIT (21)	OCCUPANT (4)	DATAPRO (35)	PACKET (7)
TRANSPORTATION (21)	SELL OFF (4)	WORKSTATION (34)	PANEL (7)
UNEMPLOYMENT (16)	TIP (4)	MB (32)	RELAY (7)
FARE (12)	BOOK VALUE (3)	ARCHITECTURE (28)	RESPONSE TIME (7)
WAGE (12)	BROOKINGS INSTITUTION (3)	SNA (26)	ROUTINE (7)
ADVERTISING (11)	BULL MARKET (3)	ETHERNET (25)	ACCURACY (6)
AFL CIO (11)	CAPITALISM (3)	OEM (23)	COMMENTS (6)
MORTGAGE (9)	CO OP (3)	DBMS (20)	DA (6)
POVERTY (9)	COMMERCIAL PAPER (3)	IMPLEMENTATION (19)	DICTIONARY (6)
STOCK MARKET (9)	CONSERVATIVE (3)	MIS (18)	EDP (6)
SURPLUS (9)	DEVALUATION (3)	INSTRUCTION (17)	HEWLETT PACKARD (6)
DEALER (8)	DIRECT SALES (3)	LIBRARY (17)	MAIN MEMORY (6)
IRS (8)	GENERAL PARTNER (3)	IMS (16)	RING NETWORK (6)
LIQUIDITY (8)	HARD CURRENCY (3)	SELECTION (16)	SPECS (6)
DIVERSIFICATION (7)	IN THE MONEY (3)	BANDWIDTH (15)	SYSTEM SOFTWARE (6)
EMBARGO (7)	INDEPENDENCE (3)	MODULE (13)	TELENET (6)
BROKERAGE (6)	JOB SECURITY (3)	BACKUP (12)	WORKBENCH (6)
CHARTER (6)	LENDER (3)	MIPS (12)	AFIPS (5)
COMECON (6)	LEVERAGE (3)	NTSC (12)	BASIC PLUS (5)
CONSUMER GOODS (6)	LIQUIDATION (3)	PI (12)	BUBBLE MEMORY (5)
DOW JONES (6)	MALL (3)	QUERY (12)	COMPUTER AIDED DESIGN (5)
FRANCHISE (6)	MERCHANDISE (3)	CHARACTER (11)	DATA COMMUNICATIONS (5)
INTEREST RATE (6)	MONEY MARKET (3)	DATA CENTER (11)	DATA MANAGEMENT (5)
BARTER (5)	MORALE (3)	END USER (11)	MAGNETIC TAPE (5)
CASH FLOW (5)	NEW MONEY (3)	PCM (11)	MULTITASKING (5)
COMMUTER (5)	OFFSHORE (3)	SUBSYSTEM (11)	OPTIMIZE (5)
COUNSEL (5)	PAYROLL TAX (3)	KEYBOARD (10)	PACKAGED SOFTWARE (5)
INFLATION RATE (5)	PER CAPITA (3)	LOGIC (10)	PROGRAMMABLE (5)
MUTUAL FUND (5)	PRICE INDEX (3)	METHODOLOGY (10)	RETRIEVAL (5)
RETIRE (5)	PROCUREMENT (3)	PLUG (10)	ROUTING (5)
SLEEPER (5)	REAL INCOME (3)	PORTABLE (10)	SCAN (5)
TRADE DEFICIT (5)	RED TAPE (3)	UPGRADE (10)	STATE OF THE ART (5)
URBAN (5)	STRETCHOUT (3)	VAX (10)	THE SOURCE (5)
ACCRUAL (4)	TENDER (3)	AUTHORIZATION (9)	TRANSMIT (5)
ADULT (4)	YARD (3)	DATA ENTRY (9)	VERIFY (5)
BALANCE OF PAYMENTS (4)	ALIEN (2)	INDICATOR (9)	WP (5)
BALLOT (4)	AMENDMENT (2)	MASTER (9)	CDC (4)
BIG BOARD (4)	BIG BUSINESS (2)	SERIAL (9)	COLUMN (4)
BRASS (4)	BIG THREE (2)	INFORMATION TECHNOLOGY (8)	CONCURRENT (4)
CARTEL (4)	CAPITAL INVESTMENT (2)	KB (8)	DIAGRAM (4)
FRAUD (4)	CENTRAL BANK (2)	MHZ (8)	ECOM (4)
GNP (4)	CENTRAL PLANNING (2)	REAL TIME (8)	HIGH RESOLUTION (4)
HOUSING STARTS (4)	CHAIRMAN OF THE BOARD (2)	BPS (7)	IMAGE PROCESSING (4)
IMF (4)	CHIEF FINANCIAL OFFICER (2)	COMPUTER INDUSTRY (7)	INTERNAL MEMORY (4)
INITIATIVE (4)	CONFIDENTIAL (2)	CONFIGURATION (7)	LINKAGE (4)
LEGACY (4)	CONFLICT OF INTEREST (2)	DISKETTE (7)	MICROCODE (4)
MARKET PRICE (4)	CONSTITUTION (2)	INQUIRY (7)	MODIFY (4)

The Rising Value of Certification in Information Technology

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ABSTRACT

Research into the value of certification in Information Technology has shown that that value is on the rise. A contrast is made between broader-based certifications such as the CCP and product-based certifications such as the CNE. Many companies are using certification for making downsizing and promotion decisions. It is also viewed by employees as a benefit to their career development. A quality pre-test training program provides the Information Technology employee with currency and an expansion of their knowledge base in the field. Companies are supporting certification with extensive pre-test training and that is viewed positively by the employees. Attainment of the certification is shown to be a strong motivator for the IT professional.

INTRODUCTION

Since 1962 when certification of computer professionals began, over 50,000 individuals have attained certification from the Institute for Certification of Computing Professionals (ICCP). Newer certification programs such as the Certified Netware Engineer (CNE) by Novell (currently over 25,000 certificate holders) and a host of certifications from Microsoft, WordPerfect, Lotus, Banyan, Oracle, UNIX, and even hardware vendors have swelled the ranks of the "certified". There is no doubt that the numbers are increasing daily. However, what does certification mean to the organization and the individual?

RESEARCH ON CERTIFICATION

Over the years, various surveys and research projects have been undertaken to determine the benefits of certification. An extensive project ("Influence of the Certificate in Data Processing on Career Development") was undertaken in 1984 on the Certified Data Processor (CDP) from the ICCP by one of the authors. The project entailed surveying 25,000 certificate holders and their supervisors. CDP holders were queried as to the perceived value of the CDP designation on past and future career development. Supervisors were queried on how they compared computer professionals with and without certifications. Some of the significant results were:

1. CDP holders felt they were able to

contribute more to their profession as a result of attaining certification.

2. CDP holders as a group were aware of the need to keep current with developments in their field and were more likely to pursue higher degrees.
3. CDP holders saw themselves as receiving more prestige and recognition for job performance than their peers and had an increased sense of self-satisfaction.
4. Supervisors viewed certification positively as affecting career development and encouraged other employees to pursue certification.
5. Supervisors viewed CDP holders as being superior to other employees within the organization.

In 1994, Dataquest Worldwide Services Group reported the results of their study, "Technical Training and Certification: Outlook and Opportunities". This study was prepared for five of the largest information technology corporations in the world and one of the largest training organizations in the world. The study covered certifications in many areas of the information technology industry. Their study involved 8535 surveys from certification candidates and 400 manager interviews. Their detailed results showed that:

1. A majority of managers reported that they get more value out of certified employees.
2. Managers hoped to improve service quality through certification: i.e. improve productivity levels, improve service quality, keep current in technology, and assist in hiring and development.
3. 98.8% of candidates surveyed saw value in certification.
4. More than half the corporate managers surveyed believe that certified professionals have greater self-esteem.
6. Large corporations are more likely to have certified employees.
7. Over 40% of the candidates went through formal training programs to achieve certification and over 85% of companies surveyed paid for the associated training and actual certification.
8. Enhanced by experience, certified employees can improve service, performance and productivity.
9. More than half of the manager's surveyed, agreed that certification testing provides a fair and accurate reflection of employee skills.

The overall conclusions by Dataquest were:

1. The importance and value of certification is increasing.
2. Certification needs to be extended to address broader Information Technology requirements.
3. There is a need to develop processes to help quantify the benefits of certification.
4. There is a need to develop processes to measure the impact of certification on performance, productivity and customer satisfaction.

DIFFERENCES BETWEEN CERTIFICATIONS

There are differences between types of certification. Certifications such as the Certified Computing Professional (CCP) from the ICCP, seek to verify broad, general Information Systems knowledge in their "Core" exams. They also have specialty areas which are more technical and focused closer to the current frontier of technology. While these examinations are still more broad than examinations covering a single product, i.e. WordPerfect, Word for Windows, they are more narrow than their broader based core examinations. They are also not leading edge technology examinations.

There is an important distinction between the technology frontier for Information Systems Technology Certification and a specific vendor or company's current frontier of technological advancement. For example, AT&T's technological frontier is far more advanced in wide area networking technology than Novell's wide area frontier. Yet, Novell's local area networking technological frontier would be far more advanced than AT&T's local area networking frontier. Additionally, both of these frontiers would be significantly advanced over a department store's technological frontier. It is important for the certification technology frontier to be appropriately placed for the certification population which will be tested.

Certifications in a particular product or area would be more technologically current in those products since candidates for certification in the use of that product are presumed to be using that specific product. A CNE candidate to become certified in Novell Netware, Version 4.x would be tested on information from earlier versions as well as newer versions of 4.x. Even here, the latest in LAN technology might not be appropriate since the candidates are not working in research at Novell, where the frontier would be even further extended.

As you can see, establishing the current frontier can be a very difficult problem. This has led to many unfounded complaints against the ICCP certification process. While it is easy to say that the frontier is not advanced far enough in the areas we are working in, we would also complain vigorously if the frontier were beyond the scope of the jobs we currently hold.

WHY ARE COMPANIES SEEKING TO CERTIFY THEIR EMPLOYEES?

Why are more companies seeking certification for their information technology professionals? Since there are more certified professionals in our field, it is more logical to assume that there are more certified managers than ever before. These managers have seen the benefits upon their own careers and support the certification process. We've also experienced a very tight economy and simultaneously a movement toward downsizing in most organizations. When there are a high number of applicants for a limited number of positions, the selection process can be made more efficient by using pre-programmed decision making such as requiring specific experience, formal education and certification. In addition, rapid changes in technology is forcing retraining of our "legacy information technology professionals". These professionals need to have a method of showing their new found knowledge to potential employers. Some of these individuals have undertaken this training while unemployed or under-employed as non-information systems technology employees. Certification testing is often seen as confirmation that this training produced significant learning by the individual.

There is an additional value often overlooked in certification. The process of preparing for certification refreshes prior education and experience and brings a more current awareness to items that have paled in value over the years. The project leader who has done little programming in the past few years may become more aware of new programming techniques and their similarity / differences in older techniques. The programmer/analyst who has been writing and developing systems for the last few years will become more aware of the financial aspect of the firm when accounting is reviewed during the certification training process. Many employees develop what we call "company tunnel vision" by following only procedures and techniques in place in the organizations where they have been employed. Even an individual who has been limited to programming for several years loses much of their systems skills and have not been exposed to many of the new systems methodologies. Certification exposes them to newer and more appropriate techniques and technologies.

Preparing to take the certification can be accomplished in many ways. Often the candidate will do self study. While this can be effective for some employees, formal training/reviews can provide many benefits. Training is more beneficial in areas where new knowledge needs to be acquired. For example, a computer scientist preparing for the Certified Computing Professional examination (formerly the CDP-Certified Data Processor), would learn more about business, finance, and management since they have no formal education in these areas in most university programs. Understanding the business demands placed upon the firm and the manager, can help the employee appreciate many situations they might not have previously understood. An Information Systems auditor would learn more about database, computer languages and operating systems when they prepare for the CISA (Certified Information Systems Auditor) examination. Understanding the more technical aspects of the Information Systems Professional will help the Auditor understand the demands of the programmer/analyst and help the auditor when making systems recommendations in the future.

Passing the certification examination can be a motivational experience. Research has shown that certified employees are more likely to continue their education and seek additional certifications. In many cases, employees who had dropped out of formal education programs are encouraged to return and complete their degrees. Employees who felt that achieving a Bachelors degree previously are often encouraged to pursue higher education.

CORPORATE REACTIONS TO THE CERTIFICATION PROCESS

Over the years specific corporations have supported the certification process in varying degrees. For example, more progressive companies such as Pacific Bell have paid for employee pretest training, as well as the tests taken by their employees. "We need the testing of certain specific technological knowledge, but we also need the focus on management and other skills that the ICCP brings us. ..we have fewer [IS] people doing more things. You can't afford tunnel vision focused on one technology anymore." says Christine Johnson, a human resource specialist in product technology and support for Pacific Bell Corporation in San Ramon, Calif. Jack Hancock, former Pacific Bell Vice-President of Information Technology, has publicly stated he would like all of the company's IS workers to receive ICCP certification.

Both research studies mentioned above found corporations willing to support employees in their pursuit of certification. Some companies have begun to use certification as a discriminator in their downsizing effort as well as a consideration in promotional opportunities. In some cases, it is even a requirement of the job. Additionally, some universities grant credit to ICCP certificate holders.

CONCLUSION

In conclusion, Information Technology professionals and organizations are seeking various forms of certification to verify knowledge and skills. Corporations are assisting their employees in their pursuit with both "a carrot and a stick" approach. Paying for pretest training and testing is the carrot; requiring certification for promotion and utilizing certification in their downsizing is more of a stick approach. It is clear to these authors that the value of certification is unquestionably on the rise in the Information Technology industry.

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Artificial Intelligence and Factory Level Criteria

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ABSTRACT

Artificial intelligence, or AI, as it is known by the computer literati, entails the use of computer software to determine whatever you want to know. The plethora of forecasting software being introduced in the commercial market means that future managers will have a wide variety of forecasting packages from which to choose, since most forecasting instructors have either developed their own software or are using general computer packages such as SAS, Minitab, SPSS, and Sibyl Runner. Artificial intelligence is beginning to offer business and industry a vast array of new tools. Already helping to uncover subterranean oil deposits and design computer chips, AI is expected to be in general use among companies and government agencies virtually everywhere by the end of this century.

INTRODUCTION

From the earliest times in recorded history, man has been drawn to the idea of creating intelligence outside the human body, that is, "artificial" people. During the 19th century, Charles Babbage experimented with "intelligent" machines. In 1956, a group of leading scientists gathered in Dartmouth, stating unequivocally that, "in 10 years, computers [will] be as smart as people (Turban, 91). Despite such early bravado, it is only within the last few years that artificial intelligence (AI) concepts have gained commercial viability. After several decades of confinement to the ivory tower, AI in general, and expert systems (ES) in particular, are finally available for use in business environment.

An expert, or knowledge-based system is a computer system that applies reasoning methodologies to knowledge within a specific domain in order to provide recommendations or advice, much like a human expert (Rich, Knight, 91). In fact, the Turing test for an "intelligent" computer system is one in which a human interviewer converses with both an unseen human expert and an unseen computer system, and cannot distinguish between them (Turban, 92). Artificial intelligence, and its offspring expert systems, are now emerging in the form of commercially viable systems development tools involving shells and special-purpose programming languages. Recent surveys illustrate growing interest and activity in small and large business organizations. For example, 53% of banking organizations are currently using or developing some ES applications (Plath, 89). 70% of mid-tier insurance firms are using, developing, or panning ES applications (Jones, 90). In one survey, 84% of the respondent had implemented ES, were developing ES, or were considering ES development (Philip, 90). In addition, a few commercial ES have now been in place long enough to provide inspiration and insight into keys to success and pitfalls to avoid. (Blackman, 90, Alexander, 91).

The literature strongly suggests that ES technology is indeed more than a fad. It has proven invaluable to those organizations willing to invest and coordinate time, money and talent in the effort. Several recent studies have highlighted the benefit achieved. Some recurring themes are found in the literature. Improved productivity is often stated as an important reason for investing in ES technology. Cost reduction, innovative training tools, and the capture of scarce resource are also often provided as valuable reasons to employ this new technology. Often the value of a single human expert has been distributed throughout an organization via ES technology. Other reasons include competitive advantage, better customer service, improved product quality, better management communications, improved definition of professional activities.

AI CHARACTERISTICS

Science writers love terms that connote mystery. "Artificial intelligence" is one of their favorites. It has a futuristic, Slash Gordonishring to it. But AI-which can be defined simply as the capability of a machine to mimic intelligent behavior- is really neither far off nor far out. It's here, now, and it's beginning to change the way we live. Though AI may still be misconstrued by some as a danger toy, it is basically nothing more than sophisticated electronic circuitry rigged up to manipulate symbols in the same way that people do when they reason through problems and come up with feasible solutions. For example, AI technology is now making possible a sophisticated type of problem-solving activity called rapid prototyping, which involves simulation based so closely on reality that user can visualize real-life implementation. NASA scientists turned to rapid prototyping after spending eight years trying to eradicate carbon dioxide from space shuttles and solved the problem in four weeks. A major U.S. airline has developed an AI system that optimize seat revenue by analyzing such factors as capacity versus tickets sold, allocation of full fares and discounted ones, number of days until departure, competitive airlines' seats available, and so forth. For the airline, the benefits are significant: increased profit, more efficient use of personnel and facilities, and a competitive advantage. An AI system-called "Just In Time Manufacturing" aims at reducing costs and improving quality on factory production lines by virtually eliminating the need for inventory and storage. The "Just In Time" system simulates a factory's entire production flow via representations of various workstations and tools that appear in "windows" on a video screen. It shows not only the functions and relative speed of each tool, but also how much lead time is needed to order parts for each step along the way.

The system also suggests ways to correct bottlenecks by moving people and machines around to change the product flow, thus indicating which configuration is most productive. Another AI system being developed takes aim at automating the diagnosis of printed-circuit-board failures. The system has already demonstrated its ability to pinpoint faulty devices with a minimal number of probes, while it frees up valuable human resources. The potential cost $1.5 million and is operated by a highly skilled technician, while the AI approach uses a program that costs less than $100,000 and can be run by someone with just two weeks of training.

Expert Systems

Programs like the ones described above are called expert systems so named because they contain the collected, computer-stored knowledge of specialists in a given field. An expert system can draw on mountains of data to make a decision based on its stored knowledge about a given task. Artificial intelligence's scope also encompasses natural-language processing, robotics, and vision and speech recognition. But-at-least for the moment-the most promising advances are in the expert systems area. Potential applications for expert systems are in such diverse areas as health and human services administration, communications systems simulation, electronics systems simulation, electronic data processing audit, natural-language interface, and airline pilot assistance. Pilot assistance, or flight management, offers another good illustration of AI's practicality. Think of all the cockpit gadgetry with which a pilot has to contend. Some newer planes have more than a hundred computers spewing information onto the instrument panel. It's all important, but it can also be pretty confusing when a sudden problem demands an immediate response. But AI programs now being perfected will someday, when presented with an emergency, significantly reduce the display critical information, and tell the pilot what options are available for corrective action. Ultimately, that is just what AI lets the user do: obtain useful information from huge data banks faster, perform certain crucial tasks better by precisely narrowing down the available options, develop rapid prototype solutions for complex problems, and improve the users understanding of what their computers are doing for them.

Power Packs

Another promising development in AI is the creation of "power packs"-specialized AI tools, or system "drivers"-which contain generic knowledge that can provide solutions to specific problems found in particular industries or fields of endeavor. One such "power pack" is already helping the utilities industry to design and build new plants. What it does, in effect, is allow users to place simulated boilers and pipes and valves video screen while a software program runs fail-safe checks on the design. Any company serious about participating in the AI revolution must be willing to invest heavily in R&D to make sure that its expert systems and other AI programs operate directly with data already held in traditional information-processing systems and that the programs keeps up with software innovations. In addition, such a company must be willing to initiate extensive training programs, increase support for university research project, and team up with other companies to undertake joint ventures so that products can be delivered in a smooth, timely fashion.

Expert System for Business Forecasting

Forecasting model election consultation system (FMSCS) is a prototype forecasting expert system which can help novice forecast users to make the right decision about selecting a model. The expert system approach for a forecasting application is needed, because of several reasons: First, forecasting is more an art than an exact science. A forecasting expert solves a particular problem by dealing with the constraints of the problem and by matching the characteristics of the various forecasting models with the problem. There is no set problem solving procedure in forecasting. A formal algorithmic approach is not suitable for solving an unstructured problem as is the cast in forecasting. Here, the expert system is highly approach to solve such a problem. In addition, the expert system can apply a systematic reasoning process with a very large knowledge case which is often larger than a forecasting expert can retain or utilize. Furthermore, the expert system is objective and not influenced by perceptions that are not relevant to the problem. Expert system are often cost effective. Forecasting expertise is either very expensive or not available. The forecasting expert system approach can go beyond the model selection stage. It can also provide help in identifying a particular model, within its category. For example, a forecasting software, AUTOBOX, applies the expert system approach to identify automatically a definite Box-Jenkisn model for a time series. The forecasting model selection consultation system (FMSCS) is personal computer based prototype forecasting expert system. It is implemented with Turbo Prolog language. Its menu driven system has three basic components: (1) consult the forecasting expert system, (2) review forecasting rules and models, and (3) update forecasting rules. The first option, consult the forecasting expert system, will facilitate a user to select an appropriate forecasting model for his problem. The system asks two types of questions: (1) yes or no, and (2) a multiple choice. A user has to answer yes or no to the first type, and select a choice on the screen for the second type. The sequence and the number of questions asked in each consultation are different. The selection of a subsequent question is based upon the preceding question. The second option review forecasting rules and models, allows the user to review easily the knowledge base. A user can select a forecasting model and review its production rules if he/she so wishes. It also helps the user to understand each model included in the system. This option allows a novice user to have a basic idea about a model and gives him references for further study. The third option, update forecasting rules, allows the user to edit and update the knowledge base. The user can select a forecasting model and edit its rules if he/she desires. Under certain conditions, this is a desirable feature. This is one of the ways to customize the production rules to fit a specific forecasting environment and/or company requirement. The production rules can be easily updated or deleted in light of the latest research findings. At present, this option allows the user to modify the scale of rangechar rules of the knowledge base. Production rules of an individual model can be modified by using the Prolog editor or a word processing package. A number of enhancements are being currently developed which will make this system even more useful. These include: (1) The criteria useful to select the best model is being extended to include tests of the residuals and other statistics combined with our goodness-of-fit measure. This provides added assurance that the mist appropriate model specification is selected (2) The time series methodology is being expended to consider independent variables within an econometric framework. The econometric model would include tests for statistical significance and the appropriate coefficient signs. In addition, an automatic testing procedure is being developed to consider the optimal lag length. With this, the time-series methodology currently employed would become a subset of an even larger framework. (3) This system is being modified for PC use utilizing the PCSAS, MicroTPS, and Gauss packages.

AI NEURAL NETWORK

A great deal of importance has been given in recent times to the development of expert systems and the attempt to do so has met with the problem of traditional knowledge phase of developing expert systems. In the attempt to develop such systems the problem of securing the necessary knowledge and information from experts in the field has been proven to be a costly chore. This we find because it is time consuming, susceptible to error and thus preventing the development and use of a different systems. This so called "knowledge engineering bottleneck" has led to a deeper check into techniques of developing experts systems. A number of strategies have been set up which are appropriate for classification problems which have proven to be one of the most common and successful applications areas for expert systems. Each classification has been investigated and have been compared with each other. FLD has been used for a long time in the inductive modeling of the classification behavior of Experts. Since FLS is concerned with best fitting linear functions, a great deal of criticism of these linear functions has been raised by artificial intelligence and researchers of Expert Systems. This FLD is still considered one of the most popular inductive tools for setting up classification models because of its simplicity. LRM has been considered as an alternative to FLD because it does not demand a strict set of assumptions on the data as does the FLD. The ID3 is a simple operation for discovering a set of classification rules and organizing them in the form of a decision tree which can be gathered for any collection of objects. An algorithm is proposed that will collect objects of a certain class (approved loan application) which are known by a set of variables and then develop a production system which classifies the objects correctly. In the use of the ID3 algorithm the difficulty is that the lower branches of the tree specializes in the characteristics of individual cases in the training sample. This gives poor performance when applied to new cases. RPA differs from ID3 by using a method to deal with uncertainty in the information used to build the tree. The heart of the RPA algorithm is involved in the use of "cross validation" to find "a right size tree" by pruning a full tree.

The next step is to select a certain tree out of the group of trees. The point is to select the tree with the smallest true error rate. "The selected" right sized tree is the simplest tree which is within one standard error of the minimum cross validated error rate." The NNBP is one of the many algorithms that is part of the newly received artificial intelligence technology known as "neural networks." The purpose of a neural network is to stimulate the biological functioning of the human brain. In a "neural network" the unit likeness to the brain neuron is called a "processing element." The NNBP network is made up of three layers: 1. an input layer 2. a hidden layer with a sufficient number of elements to solve the problem 3. an output layer with some number of processing elements as there are classification categories. A proof has been given - a proof which show this function is a nonlinear regression function. The performance of each of the classification models in terms of the five training data sets. It was found the ID3 algorithm produced the best classification performance - 100% correct classification on all five of the training data sets. The cost of perfect classification is that ID3 algorithm must build a large binary decision tree. The second best average classification accuracy of 93.5% was achieved by the NNBP model. This model consisted of five input elements, three hidden layer elements and two output layer elements. Standard cumulative back propagation was employed with a sigmoidal transfer function used in hidden layer. The third best average classification accuracy of 87% was achieved by RPA. The Binary decision trees are considerably smaller than those produced by the ID3 algorithm. Since RPS sacrifices performance on the training data in order to achieve better performance on the validation data. In this case the RPA decision tree consisted of only 3.6 nodes. The LRM came in fourth with an average correct classification rate of 79.5. The five independent variables were used in the model. The worst performance achieved by FLP with an average classification rate of 78%. As with IRM, all five variables were employed. With above information and the relative classification performance of the three AI - based inductive classification models was shown to be superior to the two more traditional statistical methods on both training and validation data.

COMPETITIVE ELEMENTS OF ES

Competition among corporations is very strong internationally. In order to attain competitive advantage, corporations must discover new techniques. One important component to competitiveness is effective and efficient management of company resources. These resources consist of the expertise and intelligence contained within the organization. Information technology has enabled corporations to find new ways to achieve competitive advantage and expert systems is one method. Combining the knowledge and wisdom of key figures within the organization help provide numerous benefits in attaining competitive advantage. The benefits of an expert system are numerous, for instance, an expert system can combine the knowledge and information a few important individuals possess in an organization, information could be lost because of departing employees and an expert system may save money on skilled labor. The application of an expert system should be included as a standard process within the organization in order to achieve competitive advantage. In order to project future circumstances, a corporation's strategic planning process should include the appraisal of areas of expertise important to the organization processes. The organization must implement a strategy describing the formulation and employment of expert system technology. Documentation of organizational priorities should include personnel, resources and time frames which also assists when future problems arise. The strategy must include flexibility and allow for alterations. Expert system potential is assessed through the expertise intensity of an organizational process. The expertise intensity overlay is utilized to evaluate areas of organizational expertise which suggest an opportunity to attain competitive advantage. The established techniques of this appraisal include: strategic opportunities framework, critical success factors, the framework to determine successful exploitation of information systems technology, the framework for identifying strategic information systems and resource allocation priorities by strategic business unit to name just a few. The strategic opportunities framework addresses two questions. Firstly, will the utilization of an expert system alter the way which business is managed or concentrate on improving conventional products or processes? Secondly, should efforts be aimed toward internal operations or the marketplace? When expert systems are applied to both questions, the benefits are enormous. The advantages include: promoting a leading edge image connected with state-of-the-art technology, standardizing expertise and enabling consistent quality in decisions, as an educational support for cultivating the expertise of new and current employees, increase efficiency and productivity through quicker response in troubleshooting and answering questions, and better use of expert's time.

AI & DIAGNOSTIC TECHNOLOGY

Managers across the country are intrigued by tales of computer programs that can configure customer's orders, diagnose machine failures, and make credit decisions with little human assistance. These programs are called expert systems (ES) for their ability to employ human knowledge and judgement to solve problems that ordinarily require human expertise. As with any other technological innovation, an important key to the acceptance and use of ES in organizations lies in its effective implementation. Implementation of more complex systems requires much more planning and effort than any other system. Assuming the goal of the ES is to increase the productivity of people, it is important that those factors that are important in managing the implementation of the different types of ES be identified.

Expert Systems As Innovation

In more traditional IS, carefully laid out specifications are created before software development begins. ES, on the other hand, are usually developed via rapid prototyping. Another important differences lies in the knowledge acquisition process. IS systems specifications are usually highly structured and relatively easy to communicate. Expert knowledge, on the other hand, is commonly very difficult to express since it involves ingredients such as intuition and the dynamic application of years of experience.

Categories of ES

ES can be classified into one of four groups: Personal Productivity, Knowledge Intensive, Technology Intensive, and Strategic Impact. It has a high degree of knowledge complexity but is technically simple. Since all systems within each group share similar primary attributes, research on systems within a group should be more generalizable to the group as a whole. This typology is used to guide ES implementation.

UNCERTAINLY OF BUSINESS ES

Expert Systems are programs designed to mimic human experts in solving real world problems. Real world business problems, that demand the attention of experts are typically characterized by a large amount of uncertainty. Initially ad hoc techniques were used to deal with the problem. However, formal techniques for dealing with uncertainty, based on existing statistical theories developed as a separate and parallel field. In many problem domains the knowledge available may be unreliable, incomplete, imprecise, vague or inconsistent. In expert systems developed in such domains,uncertainty can manifest itself in the problem data, as well as in the rules of the system. Expert systems try to accommodate uncertainty in the data, by allowing the users to express their confidence factors (cf) are numeric values usually in a scale of -1 to 1 (from definitely false to definitely true) and is intended to express the user's subjective assessment of the validity of the data. Rules in expert systems tell the inference engine what to do if certain situations exist. A rule typically has a premise and a conclusion and is expressed as "if A Then B". All rules however cannot be stated in such a simple fashion. In real life situations, it is often difficult to determine if a premise is true. Expert system developers provide for system probabilities or certainty factors as number attached to rules. In order to deal with the numerous manifestations of uncertainty, researchers in the fields of artificial intelligence (AL) and statistics have proposed numerous theories.

DISTRIBUTED AI

Because of the successes of many AI projects, AI researchers have attempted larger and more complex problems. When a system is very large and complex, a single expert often finds it too difficult to solve problems alone. Often a team of experts is organized to share the tasks and put their efforts together to solve problems. Distributed artificial intelligence (DAI) works in much the same way [11]. A group of intelligent systems work together and share their information with each other. This is a powerful idea, however, DAI is still in the early stages and many technical problems need to be solved, such as communications between agents, when and how to share information, and a variety of reliability and security issues. The definition of DAI has been changed over the years since 1980. A definition by Davis is quoted below from the list of definitions from a workshop on DAI [11]. "DAI is concerned with those problems for which a single problem solver, single machine, or single locus of computation seems inappropriate. Instead we turn to the use of multiple, distinct problem solvers each embodied in its own systems." Because of the dynamic and complicated nature of the telecommunication networks, many researchers have insisted that DAI will play a major role for future network management. According to Goyal [5], current expert systems are confined to very limited domains. In a cooperative problem solving anode, several expert systems should be able to perform higher level tasks, making use of the expertise of other systems and performing better than any single expert system. Goyal also indicated that DAI in network management will provide more computing power at lower total hardware cost, has greater reliability and fault tolerance, and is an extension of current technology. Conry [2] suggests that application domains involving telecommunication systems provide a near ideal forum for investigation of problems in DAI for two reasons. First, telecommunication systems provide a rich source of interesting problems which are naturally distributed and which arc not readily solved using conventional techniques. Second, the real problems whose solutions have significance in practical situations.

AI Approaches to Expert Systems

Perhaps the decisive blow to early Bayesian schemes was the appearance of an appealing alternative approach using logical and rule-based representations derived from AI. This approach focused more on the representation and use of large amounts of expert knowledge and less on questions of normative optimality Many researchers in this area had little exposure to or interest in probability and decision theory. A key feature of the new expert system paradigm was the application of the production-rule architecture to real-world diagnosis. The appeal of production rules lay in their apparent capacity to represent expert knowledge in a flexible declarative and modular form (Buchanan and Shortliffe 1984). The production rule has the form of logical implication. To handle the uncertainly in real-world diagnosis. Investigators simply extend the production-rule representation to allow intermediate degrees of truth between true and false for both propositions and for the applicability of each rule. The two best-known approaches that represent uncertainly as an extension of deterministic rule-based expert systems are MYCIN (Buchanan and Shortliffe 1984) and PROSPECTOR (Duda, Gaschnig and Hart 1979). MYCIN, the expert system to aid physicians in the diagnosis of bacterial infections introduced the certainty factor a number representing the degree of confirmation (between 0 and 1) or disconfirmation (between 0 and -1) of each proposition or rule the basic MYCIN scheme was made available for other applications as EMYCIN and it is used in several commercially available expert system shells PROSPECTOR was constructed to aid geologists in the identification of commercial mineral deposits PROSPECTOR uses probabilities to represent degrees of belief in propositions and quantities related to likelihood ratios to quantify rule strengths, although its updating rules are not exactly consistent with a coherent probabilistic interpretation. A common objection to probabilistic approaches is the difficulty of assessing prior probabilities degrees of belief in hypotheses before evidence is available empirical data are often hard to obtain and subjective judgments can be unreliable. MYCIN (although not PROSPECTOR) appears to evade this problem by not requiring prior beliefs. Contrary to many popular interpretations the certainty factor was originally intended to represent an update or change in belief induced by the evidence , not an absolute degree of belief (such as a probability) (Heckerman 1986; Heckerman and Horvitz 1987). Thus it aggregates the overall change in belief given the evidence without having to explicitly represent the prior or posterior belief in each hypothesis. When MYCIN suggests a treatment for an infection it effectively uses the certainty factors for the diseases as a proxy for their relative probability. Because it avoids explicit reference to priors . It is in effect treating all infections as having equal prior probabilities.

AI and DA have traditionally played to different audiences. The primary consumers of decision analyses have been decision makers (DMs) faced with particularly important decisions. These DMs hire analysts to encode the information relevant to their decisions, to help them organize their own thoughts, and to recommend "rational" decisions. Since computation has always been one of the greatest barriers to successful analyses, members of the DA community have long recognized the importance of automation (Edwards 1962). In addition to automation, IDs addressed a long-standing problem of the DA community, namely the complexity of representing hierarchical Bayesian inference. The difficulty inherent in this task can probably best be appreciated by comparing Schum's excellent analysis of inference without the use of IDs (Schum 1989) to any of the analyses that use them (Howard 1989). Throughout most of AI's formative years, on the other hand, the field was essentially restricted to a few research laboratories. This isolation changed in the early 1980s, with the development of expert (or knowledge-based) systems. These systems are based on a simple idea: elicit large amounts of information about a general problem domain from human experts, encode it into a system, and then apply it to solve individual instances of the problem as they arise. One of the most confounding research problems to plague the designers of these systems was uncertainty. How should knowledge-based systems use information that is incomplete, imperfect, or otherwise less than certain? Several schools of thought emerged, ranging from the qualitative and symbolic to the highly mathematical (Nag and Abramson 1990b). Despite the obvious appeal of probability theory, many AI researchers preferred ad hoc symbolic approaches and/or quasi-probabilistic calculi because they perceived a variety of representational difficulties with probability theory. Some researchers, however, remained within the framework of probability, and addressed its reputation for representational awkwardness by combining it with graph theory to support the algorithmic powers.

AI & MANUFACTURING PROCESS

Artificial intelligence on the factory floor is usually equated with robotics, but that concept is much more limited than reality. The fact is there are more commercial applications of AI technology in manufacturing than in any other field, including finance. Most recently, vision systems have been incorporated into the inspection process. And voice technology, sometimes coupled with natural language processing systems, is now being employed for hands-busy tasks such as physical inventory. Until recently, the most advanced of these systems have been developed in-house and were proprietary. Companies that made the large investment necessary to develop them did so either to fix problems they would prefer the public knew nothing about or to give themselves a competitive edge that might evaporate if the competition knew the tools existed. Consequently, specifics about these advanced systems were usually embargoed. But now a growing number of knowledge-based, or expert, systems are coming into public view as some companies lift the veils off their proprietary technology and as customizable commercial systems begin to hit the market. The best known in-house expert system is Digital Equipment Corp's configuration expert called R-1 during development at Carnegie - Mellon University and renamed Xcon when DEC assumed responsibility for its continued development. Working from customer orders, Xcon develops configuration specifications for about 90% of all Vax computers systems that DEC ships and is reported to be saving the company some $18 million each year by reducing the number of components manufactured unnecessarily. The development of knowledge based systems to support strategic decisions, in contrast to other functional areas of business activity such as marketing and production has progressed slowly. The reason for this slow development is partly due to the nature of strategic decision domain which is less structured , involves more creativity, and involves evolutionary factors relating to organization specific contexts. Besides the traditional bottlenecks of the knowledge acquisition process, the expertise may not be portable across and within the organization.

Strategic choice has been characterized as a complex, ill structured problem. The complexity arises from the large number of variables, both internal and external to the organization, that have to be considered. The ill-structuredness arises from the inability to specify logical, mathematical, or statistical relationship between the variables and the appropriate strategy. Most choices are guided by intuition and a few heuristics. This means that the problem domain covers a broad range of variables and at the same time does not involve many rules, as opposed to problem that are deep and narrow. Recently attention has been directed to artificial neural networks for modeling such problem domains [3]. Artificial neural networks are particularly suited for solving complex, ill-structured problems which have been intractable under traditional paradigms. Artificial neural networks can process nonlinear relationships in contrast to traditional techniques which can handle only linear relationships. In the latter nonlinear relationships are handled by transforming them into linear relationships. It has been suggested that this distinctive ability of artificial neural networks makes them particularly suited for complex classification problems such as the problem of strategic choice.

Fuzzy Quantification & Non-numerical Approaches

The theory of fuzzy sets provides a means for dealing with vagueness of terms such as large, small etc. This approach allows linguistic terms such as high inflation to be directly entered into the system without further definition since a concept of high may be encoded directly within the program. The numeric approaches for reasoning with uncertainty have been criticized on the grounds that they do not reflect the way humans actually process uncertain information. As a consequence qualitative approaches to uncertainty representation and management have been proposed.

SUMMARY

Artificial Intelligence is an exciting development with enormous potential. As it moves out of the laboratory and into the business marketplace, Artificial Intelligence is solving problems that until now were beyond even the computer's grasp. The development of this approximation to an expert system is an outgrowth of our forecasting assignment. Since we are required to analyze a large number of data series, model development becomes a daunting task. By encapsulating the rules-of-thumb that are used in selecting a model in a series of if-then conditional statements, we have arrived at an approach that completes our assignment within a very reasonable time frame. Expert system applications can be generated through programming languages, expert system shells and knowledge engineering tools. They can be created to interact with other software, such as a database management system or DSS. In the struggle for competitive advantage, corporations must maximize expert system technology to the limit. The purpose of a neural network is to stimulate the biological functioning of the human brain.

Charts & References Will Be Furnished Upon Request.

Improving Teaching and Training: Results from a Study Examining the Effects of Attitudes on Computer Performance

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ABSTRACT

Much of the research that has examined computer training has focused on the change in attitudes (such as fear or computer anxiety) that occurs when a user undergoes some form of training. Research to date, however, has not extended this effect of training on attitudes to effects on performance (Torkzedeh and Angulo, 1992). In order to address this issue, we constructed a fields study to examine students' initial attitudes toward computers as well as students' attitudes toward computers and computer performance related to specific software tools after fifteen weeks of training. Although the relationships between attitudes and performance are interesting, the findings provide direct implications for facets that should be included in any computer training curricula. The results of this study suggest that perceived ease of use, perceived usefulness, and anticipation are all positively related to computer performance. Computer anxiety, fear, and achievement are negatively related to performance. In addition, training significantly influences perceived ease of use as well as anxiety. Surprisingly, computer training actually increased the level of computer anxiety in this sample.

I. INTRODUCTION

The proliferation of personal computers throughout public and private institutions will continue to place demands on workers at all levels to develop proficient computer skills. A component of most college curricula include some form of personal computer training. Public and private institutions are spending significant sums of money to train students and employees in specific computer tools with the goal of productivity gains. There are a variety of training mechanisms available to potential computer users. College curricula often focus on human instructors teaching and demonstrating techniques that may include hands on learning by users. Other institutions have focused on computer based training, extensive use of user manuals and written user aids, or one-on-one hands-on training. Although training can take a range of different forms, a specific training method applied to a group of users is likely to result in users with different computer abilities. Computer ability may also be related to differences between individuals, such as demographic factors and differences in attitudes related to computers.

Much of the research that has examined this area has focused on the changes in attitudes (e.g. computer anxiety) that occur when a user undergoes some form of training. Research to date, however, has not extended this effect of training to effects on performance. (Torkzadeh and Angulo, 1992). In order to address this issue, we constructed a field study to examine students' initial attitudes toward computers as well as students' attitudes toward computers and computer performance related to specific software tools after fifteen weeks of training. Although the relationships between attitudes and performance are very interesting (and will be discussed here), the findings provide direct implications for how training should be conducted. The word "how" here does not correspond to the method of training, but to some specific training components that should be included beyond tool instruction in an attempt to influence specific attitudes.

Therefore, this paper will discuss not only the results of our research study, but the manner in which these results are and can be used to improve computer training (physical and perceptual) and ultimately user performance. This paper is laid out as follows: Section II describes previous research examining attitudes and computer training. Section III presents the research questions and describes the study used to address those questions. Section IV contains a discussion of the instrument used to measure attitudes as well as a discussion of the instrument validation process. Section V presents results of the study and Section VI discusses the results and the associated impact on training. Section VII discusses conclusions and recommendations and Section VIII addresses limitations with this research study and future research directions.

II. PREVIOUS RESEARCH

Existing research examining attitudes about computers and training has examined differences in demographic factors (Dambrot, Silling, and Zook; 1988) as well as differences in attitudes (Torkzadeh and Koufteros, 1993). Much of the research that has examined this area has focused on the changes in attitudes (e.g. computer anxiety) that occur due to a training intervention.

Demographic factors that have been examined include gender (Dambrot, Silling, and Zook; 1988; Harrison and Ranier, 1992), age (Harrison and Ranier, 1992), experience (Harrison and Ranier, 1992), education (Harrison and Ranier, 1992), and cognitive style (Harrison and Ranier, 1992).

Results from these studies suggest that gender is significantly related to attitudes and performance, however, this relationship is not always consistent. Harrison and Ranier (1992) found that women were significantly less skilled than men. Dambrot, Watkins-Malek, Silling, Marshall, and Garver (1985) demonstrated that women had more negative attitudes regarding computers than men. Interestingly, a later study suggested that while women had lower computer aptitude and mathematical aptitude that men, women received higher course scores in computer language coursework (Drambrot, Silling, and Zook, 1988). Finally, other studies have identified no relationship between gender and computer attitudes (Gattiker, and Hlavka, 1992; Glass and Knight, 1988; Igbaria and Parasuraman, 1989; Munger and Loyd, 1989).

Other results related to demographic characteristics suggest that age is also significantly related to computer attitudes and skills. For example, in one study, younger individuals demonstrated greater skill sets than older individuals (Harrison and Ranier, 1992) as well as increased computer usage (Howard and Mendelow, 1991). As might be anticipated, increased computer experience was related to increased computer skills (Harrison and Ranier, 1992) and increased computer usage (Howard and Mendelow, 1991). Computer experience, however, was not demonstrated to be significantly related to computer attitudes. Marcoulides (1988) indicates that individuals with computer experience exhibit both high and low levels of computer anxiety.

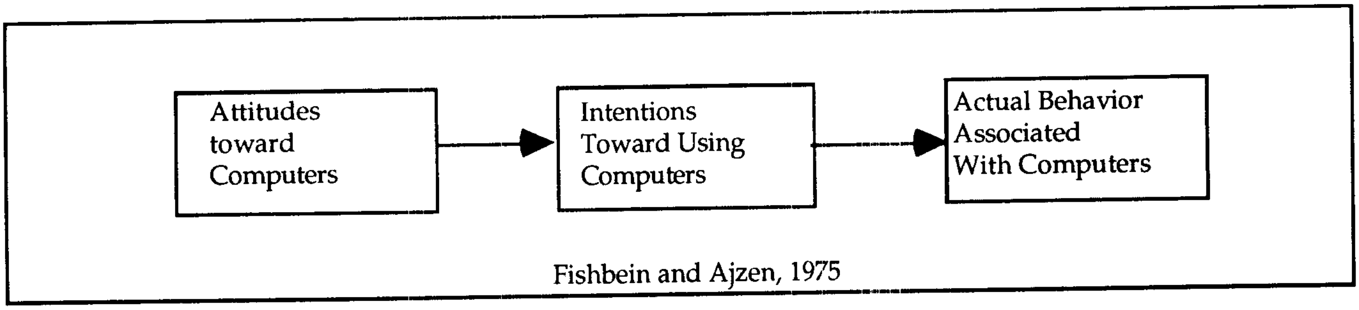
The demographic variable of education was not related to skill level even in a sample of knowledge workers where the education level ranged from high school education through Master's degree (Harrison and Ranier, 1992). Finally, a significant relationship was identified between cognitive style and computer skills--individuals that were high on originality using Kirton's (1976) Adaptive- Innovation Inventory tended to have higher computer skills (Harrison and Ranier, 1992).

The theory of reasoned action (TRA) (Fishbein and Ajzen, 1975) suggests that attitudes will influence behavior, including performance. Figure 1 describes the constructs in TRA (note that TRA also includes a construct called "subjective norms" which is not illustrated here or included in the study). TRA is not specific to computers or technology, but provides a theory for explaining many types of human behavior.

Davis (1989) and Davis, Bagozzi, and Warshaw (1989) developed the Technology Acceptance Model (TAM) closely based on TRA. TAM suggests that two perceptual measures, *perceived ease of use* and *perceived usefulness* influence attitudes toward computers. Perceived usefulness was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance". Perceived ease of use was defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, pg. 320). The perceived ease of use and usefulness constructs have been well established and measures for these constructs have been validated across a variety of samples (Davis, 1989; Davis, Bagozzi, and Warshaw, 1989; Mathieson, 1991).

Figure 1

Theory of Reasoned Action Applied to Computers



Davis and his colleagues demonstrate that an individual's initial perceptions regarding a computer's ease of use and a computer's usefulness influence attitudes toward use. In these studies, the measure of attitude toward using a computer in TAM corresponds to a general positive or negative feeling an individual might have towards computer and is not specific to any particular attitude, such as computer anxiety or computer liking.

Within the framework of TAM, neither Davis nor other researchers have attempted to tease out the specific attitudes that make up this more general attitude toward computers. A number of attitudes, however, have been identified as being related to computer use. These attitudes include computer anxiety, computer fear, computer liking, etc. (Howard and Mendelow, 1991; Igbaria and Parasuraman, 1989). Of these attitudes, computer anxiety has received the greatest amount of attention.

Computer anxiety has been the attitude of primary focus in many studies. The concept of computer anxiety closely corresponds with the concept of math anxiety (Torkzadeh and Angulo, 1992). Computer anxiety has been demonstrated to have a negative influence on computer use (Howard and Mendelow, 1991; Igbaria and Parasuraman, 1989) as well as a negative effect on computer achievement (Marcoulides, 1988). Different training methods (Harrinton, McElroy and Morrow, 1990) and instructors (Marcoulides, 1988) have been shown to have differential effects on reducing computer anxiety suggesting that careful selection of training mechanisms and instructors might improve computer use and performance. Other researchers suggest that other factors, such as training, explain more of the variance in performance and should, therefore, command greater research attention (Webster, Heian, and Michelman, 1991).

Other attitudes that have been found to have a relationship with computer skills or use are math anxiety and fear of computers. Math anxiety has been demonstrated to have a negative influence on computer skills (Harrison and Ranier, 1992) and computer use (Howard and Mendelow, 1991). Computer fear also has been shown to have a negative relationship with computer skill while anticipation has a positive relationship to computer skills (Harrison and Ranier, 1992)

III. RESEARCH QUESTIONS AND DESCRIPTION OF RESEARCH STUDY

Research Questions

Although previous research studies have been conducted to examine the impact of training on individual attitudes, prior research has not examined the effects of training on performance over a period of time. Training has been identified as a mechanism to reduce computer anxiety; however, it is unknown whether the training effects that decrease computer anxiety result in increased performance. Therefore, the primary research question of the study is:

What is the relationship between computer training and individual attitudes and performance?

Based on this research question and previous research, a number of hypotheses were constructed as follows:

H1: Individuals who perceive a computer to be easier to use will exhibit increased computer performance.

H2: Individuals who perceive a computer to be useful will exhibit increased computer performance.

These hypotheses are based on the findings from numerous studies that have examined TAM (e.g. Davis, 1989). TAM suggests that individuals who perceive the computer to be easy to use and/or useful are more likely to have positive attitudes about the computer and will ultimately exhibit greater computer use. The studies testing TAM have been based on voluntary usage, where usage of the system is the primary dependent variable.

In a mandatory usage environment, performance when using the system becomes a more critical measure than usage in and of itself. We believe that students who have positive perceptions about the computer will have corresponding positive attitudes about the computer. This will result in increased performance as tasks are easier to perform for individuals with higher perceived ease of use. In addition, individuals that perceive the computer to be useful, are likely to understand how the computer can improve their efficiency and/or effectiveness and should exhibit increased computer performance.

The effects of classroom lecture and hands-on training will allow individuals to become more comfortable with the various features of computers. In addition, the hands-on nature of the training will allow individuals to directly observe the efficiency and effectiveness gains that a computer program may provide. Therefore, we expect that:

H3: Computer training will be related to higher individual perceptions regarding ease of use.

H4: Computer training will be related to higher individual perceptions regarding computer usefulness.

The previous research examining computer anxiety suggests that computer anxiety has a negative effect on attitudes about computer usage. Computer anxiety should also have a negative effect on performance. Therefore:

H5: Individuals who have high computer anxiety will exhibit decreased computer performance.

Likewise, fear of computer can be considered an extreme case of computer anxiety. Therefore:

H6: Individuals who have high computer fear will exhibit decreased computer performance.

Computer anxiety is associated with uneasiness or discomfort related to computers. This discomfort may be mitigated through actual computer use. As individuals use computers, existing fears (e.g. hitting a key and losing a file) should dissipate as individuals realize that some of these fears may be unfounded or as they learn techniques necessary for computer interaction. Therefore:

H7: Computer training will be associated with decreased computer anxiety.

H8: Computer training will be associated with reduced fear of computers.

Finally, individuals who look forward to using a computer are likely to have positive attitudes and perceptions about computer usage and have increased performance. Individuals who have a history of high achievement in related activities (e.g. Math courses) and unrelated activities (e.g. English courses) are likely to have higher achievement in a computer course. Therefore:

H9: Individuals who have high anticipation about computer use will exhibit increased computer performance.

H10: Individuals who have high previous academic achievement will exhibit increased computer performance.

As individuals move through a training process, a better understanding of computer techniques and comfort with the computer is likely to result. Therefore:

H11: Computer training will be associated with increased anticipation about computer use.

Research Study

A field study was used to collect data to address the research questions.
Subjects in this study were students enrolled in an introductory computer course at a large midwestern university (primarily sophomores). The course consisted of class time in a computer laboratory two

days a week to provide hands on training of computer skills (DOS, Windows, Lotus 1-2-3, and Paradox). In addition, a single weekly lecture was required that provided conceptual information pertaining to technology and the business use of computers. Subjects were given a questionnaire the first week of class before students had any class exposure to computers. A second questionnaire was used to collect data after fifteen weeks of training. Students were given time (approximately fifteen minutes for each questionnaire) to fill out the surveys in class.

At the fifteen week point in the semester, students had completed eight DOS/Lotus/Paradox assignments in addition to performing two practical examinations. The format of the practical exam involved a two hour time period in which the student would be given a set of problems to perform using a PC. The exam was administered in one of the campus computing clusters (identical machines and software used to perform homework assignments). The examination scores (averaged and converted to a z-score) were the dependent variable in this study. A total of 959 subjects completed both exams and both questionnaires.

IV. INSTRUMENT DEVELOPMENT

The wealth of previous research examining attitudes toward computers and the effects of training provided a strong base of existing instruments to measure attitudes. Gardner, Discenza and Dukes (1993) examined four different existing instruments to ascertain which instrument(s) had superior psychometric properties. The instruments evaluated were Blomberg-Erickson-Lowery computer Attitude Task (BELCAT) (Erickson, 1977), Computer Anxiety Index (CAIN) (Maurer, 1983), Attitudes Toward Computers, (ATC) (Raub, 1981) and Computer Attitude Scale (CAS) (Loyd and Gressard, 1984). Their comparison also suggests that two instruments, the BELCAT and CAS have stronger psychometric properties as these instruments better reflect and measure the intended constructs. Gardner et al. (1993) also suggest that CAS has become the measure of choice for much of the research examining computer attitudes.

Many other instruments exist that have been used to measure attitudes related to computers (e.g. Heinssen, Glass, and Knight (1987); Igbaria and Parasuraman, 1991; Nickell and Pinto (1986). An examination of all these instruments was conducted to which instrument, if any, captured all the attitude dimensions we wanted to examine. The outcome of this examination was that no single instrument inherently measured the different attitude constructs of interest, however a combination of instruments would provide the measures necessary.

Therefore, measures for our survey instrument came from three sources. Davis (1989) provided measures for perceived usefulness and perceived ease of use (as previously defined) as possible antecedents to computer attitudes. The CAS (Loyd and Gressard, 1984a) was used to measure computer anxiety, computer liking and computer confidence. The definition of computer anxiety in this research referred to the psychological discomfort that might come from using a computer. This discomfort might come from using something unknown, concern over making mistakes or destroying pertinent information. Computer liking refers to an individual enjoying and feeling comfortable with computer work. Computer confidence refers to an individual's belief that he or she could successfully work with computers.

Finally, measures of computer fear and anticipation over using computers were used from the CARS instrument (Heinssen, Glass, and Knight, 1987). Although extreme anxiety might become fear, there is a distinction between the two constructs. Fear was defined as a trepidation that computers would change something about the individual, such as making the person too dependent on computers. Anticipation was defined as comfort with the idea of learning and using computer skills (Harrison and Ranier, 1992). Academic achievement provided a perceived measure of a subject's past performance in both math and other academic endeavors.

A total of 56 items were contained on these three instruments which was culled down to 42 items. Perceived usefulness (4 items) and perceived ease of use (4 items) remained unchanged from the original instrument. A minimum of 6 items were kept for each of the remaining factors. Items that seemed somewhat ambiguous or were captured by other items were selected for removal. Additional items were added to capture past academic achievement, subjective frequency of use (post training only). Demographic information (gender, age, year in school, previous coursework requiring computers in high school and college, major, school within university, course requirement, and prior experience) were captured through a different survey administered in the first few weeks of the semester.

A total of 959 subjects completed both surveys. Confirmatory factor analysis was performed on the items used in the questionnaire to assess the factor loadings of the various attitudes. Based on the items selected from the established instruments, we expected to find six factors in addition to the academic achievement factor for a total of seven factors. The confirmatory factor analysis using a varimax rotation, however, suggested a total of six factors. Following the instrument purification procedures in Lederer and Sethi (1992) items that either 1) had less than a .35 factor loading on any one factor or 2) had a factor loading of .35 on more than one factor were removed. A total of twelve items were removed based on this criteria.

A second factor analysis was run with no additional items meeting the designated criteria for removal. The results of the factor analysis continued to suggest that a total of six factors could be distinguished in the instrument. A reliability assessment was performed to determine if the factor structures could be simplified by removing items. This process resulted in the removal of three items and the return of one item initially removed. Both items were removed from the factor ultimately labeled anxiety and improved the overall reliability of the factor (.92) with no apparent loss of meaning. An item was added to the fear construct as the reliability analysis suggested an increase in the reliability coefficient. Examination of this item indicated that the item addressed important aspects of the fear construct. This examination, combined with the reliability analysis, resulted in the inclusion of the item in the instrument. The addition of this item gave the fear factor a total of three items which is considered to the minimal desirable for construct measurement. Based on the factor analysis and reliability assessment (Cronbach alpha for all scales > .70), the instrument was considered acceptable for this research (Nunnally, 1976).

V. RESULTS

In order to examine the relationship between training and attitudes as well as the relationship between attitudes and performance, correlation techniques were used. Table 1 illustrates the correlation coefficients between attitudes at each time period and the correlations between attitudes and performance. All of these correlations were significant at the .05 level.

Table 1
Correlation Matrix of Attitudes After Training and on Performance

Attitude (Time 1) Attitude (Time 2)		Attitude (Time 1) Performance		Attitude (Time 2) Performance	
Ease of Use	.36*	Ease of Use T1	.15*	Ease of Use T2	.28*
Usefulness	.14*	Usefulness T1	.15*	Usefulness T2	.17*
Anxiety	.66*	Anxiety T1	-.17*	Anxiety T2	-.32*
Fear	.38*	Fear T1	-.12*	Fear T2	-.14*
Anticipation	.49*	Anticipation T1	.11*	Anticipation T2	-.19*
Achievement	.38*	Achievement T1	-.19*	Achievement T2	-.14*

Table 2
Changes in Attitudes Related to Training and Computer Use

t-test comparison	Mean Time 1	Mean Time 2	t-value	p-value
Ease of use	3.44	3.66	5.835	.000*
Usefulness	4.40	4.36	.941	.347
Anxiety	3.44	3.73	-11.515	.000*
Fear	4.02	4.05	-.867	.386
Anticipation	2.07	2.11	-1.677	.094
Achievement	2.07	2.19	-3.860	.000*

In order to better understand the effect of computer training and to examine whether individual perceptions and attitudes changed significantly over the time of the study, t-tests were run between initial and final attitudes on performance. These results are contained in Table 2.

VI. DISCUSSION

All of the attitudes examined exhibit a significant relationship with performance (see Table 3). Subjects who perceive computers to be easier to use and who perceive computers as useful tend to exhibit greater skill performance. The change in ease of use/performance relationship is significant across the two time periods. The relationship between ease of use and performance almost doubles across the training intervention (r increases from .15 to .28).

In addition, our results indicate increased fear and anxiety are related to decreases in skill performance. This finding is particularly interesting when examined over time (and training). The negative correlation between anxiety and performance actually increased over fifteen weeks of training and mandatory system use and is highly significant as indicated by the t-test results. This finding suggests that subjects who exhibit computer anxiety prior the class are likely to continue to be anxious about computer use after going through training (r = .66). This suggests that training and use of a computer does not mitigate subject anxiety. Training and computer use may reinforce anxiety in students who indicated high initial anxiety and ultimately result in poor performance.

These findings have direct ramifications for both student and end-user computer performance. Although training techniques differ (and some training techniques may result in different findings), these findings would suggest that to facilitate the successful teaching of computer skills, a given training method should include a component to focus on attitude change. Specifically, training mechanisms should emphasize the ease with which work can be accomplished using a specific computer tool.

Another component of training should focus on attitudes related to computer anxiety. It may be appropriate to measure initial anxiety in order to identify those students high in computer anxiety early in the training process.
If these students are identified, an intervention, such as increased one-on-one instructor and student training might be considered to overcome the feelings of computer anxiety. Future research in this area should try to ascertain what factors cause students to be anxious as well as methods which can be used to reduce computer anxiety.

VII. CONCLUSIONS AND RECOMMENDATIONS

The results of this study suggest that attitudes and perceptions regarding computers have a direct effect on computer performance. In addition, formal training programs may change these attitudes and perceptions, sometimes positively (e.g. for ease of use) and sometimes negatively (e.g. for computer anxiety).

These findings suggest that various interventions might be considered to modify individual attitudes that are related to negative performance. These interventions might include more one-on-one training or increased tutoring by a peer. In addition, greater attention must be paid to the contents of a given training mechanism. In the current case, training actually was associated with an overall increase in computer anxiety. Different means of presenting material and providing computer experiences must be identified so that computer anxiety is reduced as a result of training.

Our goal as we began this research project was to advance knowledge and add to a growing body of literature about the effects of computer training. What we have found provides a formal mechanism to critique the method by which this particular course is currently presented. This critique, based on the results obtained using a validated instrument provides direction and information well beyond those found in traditional course evaluations and informal discussions between students and instructors. Clearly, we believe all of these methods are useful in evaluating computer training curricula. We believe that the findings from this study have demonstrated current areas of concern and can be used to provide a benchmark of comparison to help evaluate the effectiveness of any changes made to the course.

We believe that our sample (undergraduate college students) allows for generalizability across other collegiate institutions as well as to corporate end users. The students in this sample are individuals who have seen the growth of computers and have a solid understanding of the integral role that computers will play in their future careers.

The specific type of training that was used in this course, however, may well be unique to our institution. We believe that training does affect attitudes and perceptions, but also believe that different forms of training, different presentation methods, different levels of instructor quality, access to computers, etc. all might influence these attitudes and perceptions differently. Therefore, further testing across these factors needs to be examined to better understand the range of training effects.

Specific to a given course, however, we believe that the instrument used in this study could be used to better understand the effects of training within a given context. The approach used here should provide a more objective measure of the training effects on individuals that are available through other means. The data collection process required two twenty five minute periods within each class which was a small time investment for the amount and variety of useful data that was collected.

VIII. LIMITATIONS

As noted above, there are some limitations to this study. The generalizability of this research has to be cautiously considered across settings. The sample should be generalizable across university and college settings, however, the specifics of the training may not be. In addition, the use of college students as subjects as been criticized in past research as not generalizing to knowledge workers in the business world (Gordon, Slade, and Schmitt, 1986). The students in this study are only 1-3 years from *becoming* these knowledge workers. In addition, these students had motivation to learn these techniques as the techniques would be required in future coursework. However, given that this field study occurred over a fifteen week period, factors other than the training may also have influenced these students. Specifically, college students go through a maturing process during their education and some of the change over the fifteen weeks observed in this data might be a response to this change in maturity.

Responses to the questionnaire were self-report and students did have a student identification number associated with each questionnaire. Therefore, social desirability bias is possible (Zerbe and Paulhus, 1987). However, one mitigating factor was the size of the sample. With roughly one thousand students in the sample, individual students were unlikely to perceive that the instructor would associate responses on the questionnaire with any individual student.

We believe that this has been an important first step in examining the attitudes-to-performance linkage. However, additional research is needed to further our understanding of the nature of this link. First, this research addressed a limited set of variable which past research has shown to be important. However, there are undoubtedly other relevant attitudes that could and should be studied. Research is needed to help identify the *most salient* attitudes which are likely to affect individual performance on computers.

In addition, having identified a set of attitudes which are important, researchers should focus on what types of training interventions can be used to influence those attitudes (e.g. increase perceived ease of use, or reduce anxiety). It is possible that there is an interaction between type of training and attitude. Future research should examine such potential interactions and their effect on performance.

Finally, as suggested in this paper, another source of variation may be individual difference variables. Again, research examining the interaction between individual differences and training would be a useful addition to the literature. By identifying potential "at risk" students before training begins, institutions can design appropriate pedagogical techniques which can help minimize the potential problems for these students.

REFERENCES

Available upon request.

Using the Analytical Hierarchy Process to Assist Software Managers in Programming Language Selection: a DSS.

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Abstract: This paper describes a decision support system based on the Analytical Hierarchy Process (AHP) designed to help project managers select the most appropriate programming language for a given project. The design, development, and implementation of this DSS is discussed as well as the foundations of multicriteria decision making (MCDM) and AHP. The problem of programming language selection is discussed and analyzed based on the criteria of application, as well as language characteristics, and organizational factors. The design and compromises of problem language design are briefly discussed and directions for future research are suggested.

Introduction:

The Programming Language Selection Decision Support System (PLS-DSS) is a decision support system designed to provide decision making support to a project manager who is deciding what programming language to select for a software engineering project. Since the selection of an appropriate programming language involves many (sometimes conflicting) criteria, this decision is considered a multicriteria decision problem (Forgionne, 1990); consequently, the PLS-DSS must support multiple criteria decision making (MCDM). While there are many possible approaches to MCDM the approach used by PLS-DSS is based on the Analytic Hierarchy Process (AHP)(Page, Raiken, & McConnell, 1989). The AHP approach to MCDM will be briefly explained in this paper during the discussion of the design and development of the PLS-DSS.

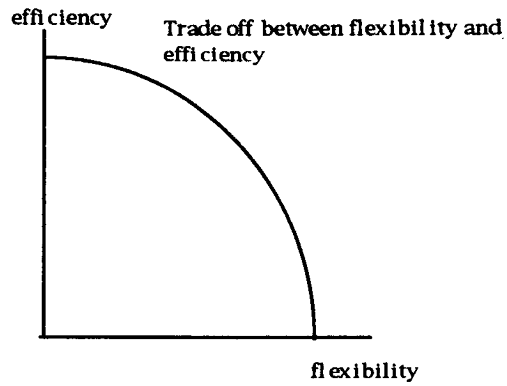
The presentation of this paper and PLS-DSS will be divided into three parts: description of the problem, design and development of the development of the system, and implementation of the system.

Description of the Problem:

The selection of the right programming language can be a critical success factor for a software development project (Friedman, 1991; Pressman, 1992). Often, however, little thought is given to the selection of the programming language used to code a project. The consequences of this can be a project that is harder to code, more difficult to implement, and harder to maintain. The end result of not selecting the right programming language for a project will be higher costs and less performance.

Background:

Contrary to the myths expounded by advocates and votaries of particular languages, no one programming language is suitable for all programming projects. Programming languages are designed and engineered like other artifacts; that is, their design involves compromises in capabilities. This trade-off of capabilities is endemic to the nature of an engineered product. For example, a car that is designed to travel fast will usually not be as fuel-efficient as a car that is designed to be economical to operate. Programming language design involves similar tradeoffs. For example, languages that are designed to be flexible are less efficient (in terms of computer resources) than languages that are designed to be efficient. Another example of the this trade-off problem is the readability/writeability design problem. Languages that are designed to be readable, like COBOL, are usually more difficult to write. The addition of "noise" words makes the COBOL program more readable but it also makes it more difficult to write. "C" would be an example of the other extreme: cryptic code makes C easy to write (if you know the language) but more difficult to read. The point is that many features of programming languages involve these tradeoffs. To further aggravate the language design problem the trade-off between these features is often nonlinear. A "production possibility" curve could be used to describe the relation between language flexibility and efficiency.



Although the above graph addresses only one "feature " in a given language, the implications are applicable to all aspects of designing a programming language: language designers must compromise in their design of a language. Advances in technology can shift the language curve outward, but for any given level of technology some compromise must occur.

Once the project manager understands that compromises are made in the capabilities of particular languages then he or she will understand the importance of making the right programming language selection for a given project. However, selecting the right language will involve the consideration of many criteria. Those criteria can be broken down into three categories: organizational factors, application characteristics, and language characteristics. Each factor is summarized briefly below.

Organizational factors: While some organizations only provide support for a single language, i.e., a COBOL shop, others may provide support for several languages. Although there are many organizational factors that can be considered in selecting a language, the two organizational factors considered by PLS-DSS are experience and HW/SW. Experience in this context means programmer experience in working with a particular language. HW/SW means does the organization have the necessary hardware and software to support that particular language.

Application Characteristics: Application characteristics determine in many ways the appropriateness of a particular language. For example, a highly text processing intensive application would be more suitable for COBOL than SNOBOL. In a similar way, FORTRAN would be more suitable for a number crunching application than COBOL. Size would also be an important application characteristic to consider. Some languages have features that made them particularly well suited for the team programming approach required by large applications (Ada) while other languages to not have those features.

Language Characteristics: Each programming language can be compared in terms of basic characteristics. Those characteristics are: extensibility, efficiency, flexibility, learning curve, readability, writeability, error-checking, self-documenting, and portability. Each of these characteristics will be examined in more detail during the design and implementation section of this paper.

As can be seen from the above characteristics, their are numerous elements that a project manager must consider when deciding on a programming language. Problem structuring is a major difficulty for this kind of problem. The amount of information that a project manager must consider can easily overload the manager's capacity to handle that information. The AHP approach provides a technique for managing the plethora of information that is needed to make this kind of decision((Dyer & Forman, 1990). Basically, in AHP the project manager breaks down the decision into a hierarchy of interrelated elements(Forgionne, 1990). In PLS-DSS those elements are referred to as criteria, subcriteria, and alternatives. Elements at each level are ranked in comparison with other elements at the same level. The pairwise comparisons in one level are used to weigh the importance of that decision element at the next level. Eventually the weights are aggregated into a set of ratings for the decision alternatives.

The AHP approach helps the manager to structure the problem by providing a hierarchical partitioning(Satty, 1989). In addition, the comparisons of decision elements allows the use of qualitative data. For example, on a scale measuring suitability for an application, COBAL can be judged to be significantly more suitable than C but only moderately more suitable that FOCUS. The advantage with using verbal comparisons is that it allows the decision maker to express the decision comparisons in ways that are meaningful for that decision maker. Consequently, the decision maker is more willing to accept the final ratings of the decision alternatives(Page, et al., 1989).

Design and Development of the System

The PLS-DSS was developed using the Criterium software package. A hierarchy of decision makers, criteria, subcriteria, and alternatives was developed. Each element within a particular level was rated relative to other elements. The overall ratings of the decision alternatives were aggregated into a final rating. A sensitivity analysis was performed (via the analysis influence command) of the final selection. The following discussion will explain the each step and rationale for development of the various criteria and alternatives.

GOAL:

The goal is to select the most appropriate programming language.

Decision makers:

The decision makers used in this problem were the project manager, team member # 1, and team member #2. The decision makers were given a 60%, 20%, and 20% weighing. In this case, all the decision makers had identical decision hierarchies. The rankings of various levels and blocks by each decision maker was, of course, different.(see attachment) The master file was completed by the project manager and the team members' files were linked to the master file. An "update" command in Criterium was used to create the overall result.

Criteria Level 1

As described in the problem description section of this paper the level one criteria are divided into three categories: organizational, application, and language characteristics. The project leader rated the three categories using direct numeric ratings on a percentage scale (see attachment for details.). The project manager rated organizational factors at 50 % whereas the team members on their individual files rated organizational factors at a much smaller amount. These ratings would probably be consistent with the actual perspective and values of the project team members. A project manager would probability have a more "organizational " perspective than the individual team members. Direct numeric ratings were used for organizational factors because precise assignment of weights could be made. Page, 1989 #8]

Application Characteristics were measured on a percentage scale using direct numeric comparisons. Language characteristics were ranked one through nine with the most important language characteristic being given a ranking of one.

Criteria Level 2

The level two criteria are organized in the hierarchy by the three level one criteria. The following is a breakdown of those factors.

Organizational factors: Experience and HW/SW were rated on a direct numeric scale. Experience was rated in terms of years experience per programmer (years/programmer). Each alternative was rated according to experience. HW/SW was rated on a direct verbal scale as a yes or no: "yes", the organization had the HW/SW to support the language, or " no " it didn't. A criterium rule was also used to evaluate the alternatives. The rule tested the organizational support for the language on a pass/fail basis. Alternatives that failed the rule were still evaluated at all levels; however, they were flagged with an identification marker.

Application Characteristics: The two factors used in application characteristics are: problem orientation and size appropriateness.

Problem orientation was measured for each alternative using abbreviated verbal pairwise ratings on a scale measuring difficulty. Size appropriateness was measured using full verbal pairwise comparisons.

Language Characteristics: The factors considered in language characteristics are: extensibility, efficiency, flexibility, learning curve, readability, writeability, error-checking, self-documenting, and portability. Each alternative was compared by language characteristic using a full verbal comparison. The following gives a brief description of each characteristic:

1. *extensibility*: Extensibility refers to a language's ability to allow the programmer to define new language components. A language that is extensible will make the development of large complex programs easier. (Friedman, 1991)
2. *efficiency:* efficiency refers to the language's ability to make efficient use of computer resources. Languages that are efficient at one type of processing may be inefficient at another type of processing.(Dahl, Dijkstra, & Hoare, 1972; Pressman, 1992)
3. *flexibility*: The flexibility of a language allows it to be used in different problem domains. However, a more flexible language is usually less efficient(Pratt, 1984).
4. *learning curve*: How easy a language is to learn depends on several factors. Learning a new language usually requires the learning of new "syntactic" information(Pressman, 1992). Confusion can occur if the syntax of a new language is similar but not equivalent to the syntax of another language.
5. *readability*: The readability of a program refers to how easy a program is to read. Readable programs are clear, understandable, and easy to modify(Friedman, 1991).
6. *writability:* A programming language that is writeable is easier to code, test and document that a program language that lacks these characteristics (Friedman, 1991).
7. *error-checking*: A language that supports error-checking will be easier to debug. Also it will easier to develop error-checking facilities for a language that supports error-checking (Friedman, 1991).
8. *Self-documenting*: Some languages, because of their source code, are referred to as self-documenting. These languages usually require less documentation that languages that are not considered self-documenting (Brookshear, 1988).
9. *portability:* Portability usually refers to the language's machine independence. Languages that are machine independent are usually more portable than languages that are machine dependent(Pratt, 1984)(Brookshear, 1988).

Alternatives:

The alternatives in the program selection hierarchy are the three programming languages: COBOL, FOCUS, and C++. These languages where chosen because they each represent a different approach to the programming process. COBOL is considered a third generation programming language and is highly procedural in nature. Users of 3rd generation programming languages are required to write precise algorithms that manipulate data structures to produce answers. FOCUS would be considered a 4th generation programming language. Usually, 4GLs are considered to be easier to use than 3rd generation languages because precisely defined procedures and algorithms are not necessary. However, 4GL's are considered to be inefficient in terms of hardware resources. C++ is considered by many people to be an object-oriented programming language (Booch, 1991). OOP is highly modular (LeClaire, 1991)and is considered by many people to represent a more effective way of programming(Loy, 1990). The difficulty of OOP programming is that many programmers trained in traditional procedural programming have difficulty learning OOP.

These three programming languages where chosen as alternatives because they represent three different programming paradigms. Consequently, the difficulties in comparing these languages using common performance benchmarks is difficult. In addition, many of the attributes discussed in this paper can not be measured in a direct, quantifiable way. The PLS-DSS provides a mechanism to support the decision maker in choosing a particular language.

Implementation of the System

The PLS- DSS is a decision support system designed to support
the decision maker in selecting a programming language. The intended decision maker would be a project member or team member who has the responsibility to select a programming language. Recommended actions would be generated in the form of reports.. Sensitivity analysis could be performed via the analysis-influence command in Criterium. The analysis-influence command allows the decision maker to see the relative importance of a given criteria on the overall outcome. Block consistency ratings also provide feedback to the decision maker. The output of the PLS-DSS can also be integrated with a spreadsheet package and the results of the final ratings shown graphically . While the PLS-DSS is a basic DSS architecture its ability to support the entire decision making process can be enhanced with additional components(Forgionne, 1987, 1990)(Young 1989) . An expert system can be aided to provide advice and knowledge about new programming languages. An idea processing system can be added to support creative thinking about software design and engineering.

Conclusion:

The problem of selecting the right programming project for a particular programming project is difficult because of the many conflicting criteria that must be considered. The PLS-DSS system provides a decision support system to a project manager who must select the programming language. The selection of the right programming language can greatly support the efficient and effective development of software systems and improve thier maintainablity.

Directions for Further Research.

Research must be conducted to help provide project managers with effective tools for managing the software development process. Decision support systems and expert systems can be used to provide assistance to managers. However, many of the previous approaches used by these systems have been ineffective due to their consideration of limited criteria and use of "only " quantitative data. Effective decision support for the complex tasks of software management requires the use of tools that can effectively model the multicriteria aspects of the decision making process and allows the use of both qualitative and quantitative data. Since the Analytical Hierarchy Process provides support for MCDM and allows the use of both qualitative and quantitative data, it holds promise as a methodology that can effectively provide decision support to software project managers. However, more research needs to be done to evaluate the potential of decision support based on AHP for the tasks of software management.

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W O R K S H O P

CAREER PLANNING FOR IS STUDENTS AND PROFESSIONALS

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ABSTRACT

Career planning in the field of Information Systems is critical to career success. In the climate of today's rapidly changing technology, it is easy to become outdated both in terms of knowledge and in practice. Although it is more important than ever to have a good foundation upon which to build a life-long career, it is also important to do career planning to meet your own more short-term personal goals and objectives. Observing the trends and impacts of the industry as a whole, and knowing how to assess them helps you know when to make a career move.

Information Systems students and professionals alike are invited to participate in this workshop to learn more about career opportunities, career options, and career planning.

LUNCHEON ADDRESS

DISTINGUISHED INFORMATION SYSTEMS EDUCATOR, 1995

The Continuing Impact of Technology on Education: The Challenges and Opportunities

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ABSTRACT

Information Technology (IT) is having a profound and lasting effect on education at all levels. Some have speculated that IT may even change the definition of education and learning. If we accept Websters' first definition of education: "The act or process of educating or of being educated", it should be obvious to all that first order change (where one changes how a task is performed) has already occurred. I believe we are on the threshold of second order change in education - changing what it is that we do. This paper presents the rationale supporting this belief.

The only thing one can be sure of in the Information systems (IS) field is change. Change will occur in our key enabling technologies and at an ever increasing rate into the foreseeable future. Each of the three enabling technologies: computing, telecommunication and video are described in the context of the changes occurring witihin them. Then the applied technology that they enable - information technology, is described in terms of four of its most critical component technologies available today: multimedia, group decision support systems, video conferencing and the Internet/WWW. The state-of-the-art of these technologies is examined individually, as emerging technologies, and collectively, as merging technologies. Then the impact that information technology has had thus far on education is described together with a preview of possible future impacts. Finally, a number of challenges and opportunities facing all of us working in education today are examined.

Market Analysis of Management Information Systems Faculty Position

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ABSTRACT

Management Information Systems (MIS) doctoral students are facing a very competitive job market now, and there is a strong need to understand the supply and demand aspects inherent in the MIS faculty position. This study is to investigate the MIS college jobs and to provide a comprehensive picture of the success factors of requirements and qualifications of the candidates. A two-year comparative analysis was conducted for the MIS graduates through questionnaire survey. Major findings are that female doctoral students are favored by most recruiting schools, the average nine-month salary of MIS new hires is above 50K, MIS candidates should hold their job search effort until they reach ABD stage, and MIS candidates with DBMS or DSS concentration have higher chance to receive job offers. The results of this paper should be of interest to MIS graduates and students who will be in the job market. The paper also has implications that apply to the universities that are hiring MIS graduates. Industry recruiters should find this study useful in understanding candidates' training background and research directions.

INTRODUCTION

Management Information Systems (MIS) has become a major discipline in the business colleges since 1970. The MIS field had gone through a severe shortage of faculty throughout its 20-year history (Jarvenpaa, Ives, and Davis, 1991). The market for MIS faculty among academic institutions is the result of the interaction of supply and demand in the labor market. In the past, the demand for MIS faculty has exceeded the supply. Therefore, most MIS doctoral graduates could have multiple academic offers before their graduation. However, the market has a recent growth in the number of new MIS doctoral programs (Grover et al., 1992) and increased number of MIS doctoral degrees granted (Jarvenpaa, et al., 1991). AACSB also has multiplied the supply of MIS faculty by offering several MIS retraining programs for college educators (Turner, 1985; Shahabuddin, 1987). With the continued maturity of MIS discipline (Teng and Galletta, 1991), the supply and demand of MIS faculty has become more balanced. In a survey conducted in 1991 (Jarvenpaa et al.), the results revealed that there had already been an excess supply of MIS doctorates (by a margin of somewhere between 0.7% and 2.3%) to the available MIS faculty positions. A majority of these excess graduates will probably re-enter the job market, causing more competition to the MIS job market. This problem, which was exacerbated by the hiring-freeze policy of many institutions, has been causing very difficult job placement in recent years.

MIS doctoral students are facing a competitive job market now. What will be the best strategy for them to locate a job? How do these students prepare their qualifications to match the hiring school's requirements? They have to answer these important questions in their job searching process. Even though several studies have described the supply and demand of MIS doctorates, very few formal studies have examined the success factors of qualified faculty in the area of management information systems. One objective of this paper is to find the relevant factors that will help MIS candidates facilitate in their job searching. We may picture the job search for an academic position as a sequential process of three major stages: procuring interviews at the conferences, proceeding on campus visits and then securing position offers (Bertin and Zivney, 1991). There are several factors and characteristics that may influence the job searching process. Two tests may be devised to investigate the number of conference interviews and job offers received by the MIS candidates.

Candidates receiving more conference interviews usually lead to more campus interviews. More campus interviews will most likely render the MIS candidates with more job offers. Therefore, one specific research question is to identify those important factors that will influence the MIS candidates on obtaining conference interviews. Once the relationship between number of conference interviews and related explanatory factors has been identified, MIS candidates can emphasize those criteria on their resume and make them become more impressive to the job recruiters.

The second investigation is to determine what factors are critical for a MIS candidates to receive a final job offer. The difference between candidates with an offer and those without one is very much a concern for the MIS graduates. For example, presently, the ratio of female to male MIS faculty in most schools is relatively low as compared to the other business disciplines. Hence, one would assume that a female MIS candidate will receive job offers easier than a male contender. Furthermore, one would believe that a MIS candidate with outstanding teaching and research record may harvest more job offers.

The objective of this paper is to examine the placement of the MIS candidates. Hence, this study is interested in exploring:

1. What are the qualifications of the MIS candidates?
2. What are their teaching and research interests?
3. Are there any factors that would help MIS candidates achieve the success of academic job placement?

The results of this paper should be of interest to MIS graduates and students who will be in the job market. Both current and potential MIS doctoral students will find the result of this study beneficial because the information can help calibrate the availability of the future job opportunities. The paper would also have implications to the universities that are hiring MIS graduates. Industry recruiters should find this study useful because they compete with academia for qualified personnel.

METHODOLOGY

The relevant market and demographic data were gathered from the MIS candidates listed in the DSI and ICIS placement booklets. As this study is interested in the trend of MIS placement, a two-year comparative analysis was conducted for the MIS graduates in 1992 and 1993. A survey was conducted by mailing questionnaires to the qualified subjects. To ensure the homogeneity of the survey data, all candidates who indicated MIS/DSS, microcomputer applications, and information systems as their primary area of interest were selected for this study. Four hundred twenty-three candidates with their interest in these three areas were listed in the DSI and

ICIS placement booklets in the two-year survey periods. For the purpose of consistency, candidates taking positions in government, industry, or foreign university were not included in the study because the questionnaire was not applicable to them.

The questionnaire in this survey was adapted from Bertin and Zivney (1991) and modified to suit the objectives of this research. The instrument was validated by giving the survey to a group of randomly selected MIS candidates listed in the placement booklets. This process resulted in some adjustments to the format and semantics of the questionnaire. After the validation the modified questionnaire was mailed to the candidates in early May of 1992. A follow-up mailing was sent six weeks later to those candidates who had not responded to the first mailing. The same processes were repeated in the second year.

In the first year, 82 candidates responded to the survey, while 55 candidates responded in the second year. These constitute a total of 137 returned questionnaires. Of the 423 questionnaires mailed to the candidates, 12 were non-deliverable, producing an overall response rate of 32.54 percent. After reviewing the responses, it was found that not all questionnaires were valid. Most of these invalid questionnaires came from respondents who either withdrew from the job market or took a non-academic position. The removal of these invalid responses resulted in 126 (75 in 1992 and 51 in 1993) usable questionnaires.

It is plausible that the survey is susceptible to response bias. The candidates who were moving to new academic positions were most likely to respond and were eager to provide the requested information. The candidates who failed to locate an academic position may have little interest in this survey, and thus be compared not to return the questionnaire. Given these response bias considerations, it seems like that the majority of non-respondents were those candidates not finding new academic positions. Alternatively, those 126 candidates accepting new positions represent most of the activity within the job market. However, the reported statistics need to be interpreted cautiously.

RESULTS AND DISCUSSIONS

Qualifications of Respondents

Teaching at the college level, either part-time or full-time, may provide MIS candidates with an edge in academic job market. To train MIS doctorates as a proper teacher, most doctorate-granting schools offer their students a teaching slot to gain teaching experience. Many schools encourage their students to have at least one year's teaching experience before their graduation. As indicated in Table 1, the 1992 candidates had full-time teaching experience of 16.2 months and had part-time teaching experience of 20.8 months. In 1993, these averages were increased to 21.8 months and 22.9 months respectively.

The market for academic MIS faculty has been described in several studies as a market for skills, especially in research (Ault et al., 1982). Candidates with these research skills can provide benefits to their department in the form of increased student enrollments, outside grant funding, recognition by the university, local community and discipline at large. Journal articles and conference proceedings papers are usually an indicator of the potential of the candidate's research capability. The findings, as shown in Table 2, indicated that MIS candidates have improved their research performance in 1993. On average, candidates in 1992 had an average of 1.05 journal and 1.28 proceeding articles. These averages are significantly improved to 1.71 and 2.39 articles in 1993.

Interests of Respondents

Teaching interests of MIS candidates suggest the areas in which they could make a contribution to the hiring department and its faculty body. To match candidate's teaching interests to prospective schools has become an important consideration in the job searching and screening process. MIS candidates show their teaching interests to seek the support and resources provided by the hiring school. The hiring schools are concerned with this issue because they could use the teaching interests of MIS candidates to balance the course coverage and augment the strengths of their existing faculty members in teaching. MIS candidates expressed their teaching interest in several areas. They include MIS, System Analysis, Decision Support Systems, and Systems Design. Teaching interests such as Programming Languages and Data Communications were found to be the least appealing in MIS candidates. The findings may indicate that most doctorate-granting schools have removed programming languages as part of course requirement and have a serious shortage of computer network resources to support data communications courses.

Research interests of MIS candidates provide the prospective recruiters with the possible research addition. Candidate's research interests also help the recruiting school in determining its new research direction. Hence, the process of matching candidate's research interests and recruiting schools' research needs may have impact on the placement decision. AI/ES was the most intensive research area in 1992 and 1993. The research interest in Systems Analysis and Design dipped in 1993, but a longer trend analysis is required to determine whether this field is losing its research attractiveness. Data Communications, Database Management Systems, and Strategic Information Systems have long been considered as three of the most important research areas in MIS. The data show that few MIS candidates expressed their research interests in these three areas.

Salary Information

42.7% of the respondents in 1992 and 54.9% of the respondents in 1993 had received academic positions in the survey. Most of these offers (67.8%) are from master-granting institutions. 20 percent of the total offers are generated from doctoral-granting institutions, while 12.8 percent of them are provided from bachelor-granting universities. This finding indicated that most job opportunities are in those universities that offered only up to master programs. The chances for joining doctoral-granting universities had significantly dropped in recent years.

The salary of new hire faculty was also tabulated and presented in Table 3. The average nine-month base salary was slightly more than $50,000 for the candidates in 1992 and 1993. The twelve-month salary was around $57,000 which includes additional income from summer teaching or research, or both. The data analysis revealed that the average salary in 1993 job market is slightly higher than that in 1992. In 1992, the average salary for new MIS faculty, on a 9-month basis, was $50,220, which was $1,639 less than those in 1993. The small increase of the salary in 1993 may just reflect the coverage of the inflation cost. However, the wider standard deviations of salary in 1993 suggested a wider variation of salary and summer compensation among the new hires.

Success Factors for Job Placement

The data were collected directly from the survey questionnaires. The SAS statistical package was used to perform several statistical analyses of the survey results. Multiple regression analyses were used to access the impact of various demographic data (i.e., age, sex, citizenship, etc.), candidates' characteristics (i.e., degree stage, teaching experience, publication records, etc.), and hiring schools' attributes (i.e., offered programs, teaching load, etc.) on number of conference interviews and offer. Two regression models were applied with the stepwise procedure. The first model is to study the number of conference interviews. The second model is to investigate the offer possibility.

Assumptions of these two regression models were first tested. Scatter plots and residual plots were also developed to detect any peculiar patterns. There were no major violations of the assumptions found in the model of offer. In the first model--test on the number of conference interviews, the scatter plot strongly suggests a linear relationship between number of conference interviews and months of teaching experience. It also indicates the error term variance decreases with months of teaching experience. Residual plot further confirms the violation of nonconstant error variance in this model. Therefore, the weighted least squares method was called in to remedy the heteroscedasticity problem. A weighted regression analysis SAS program yielded the results.

Number of Conference Interviews

The program stage of the MIS candidates has a strongly positive influence on obtaining conference interviews while candidates' teaching experience shows a negative impact on procuring conference interviews. The closer the MIS candidate is to the completion of dissertation, the higher number of conference interviews the candidate can get. The t-statistic for the program stage variable is 2.733 that is significant at the .01 level one-tail test. The coefficient of the variable (1.8995) demonstrates that candidates received approximately two more interviews for every upper stage. For example, candidates with proposal defended will obtain about two more conference interviews than candidates with ABD status. This result indicates that most schools tend to hire candidates with a terminal degree or close to the completion of dissertation. Ph.D. advisors at most doctoral-granting schools may have already recommended their doctoral students hold their job search until they reach ABD stage. Among the forty-three candidates receiving conference interviews, 14 had terminal degrees, 17 had defended their dissertation proposals, and 10 were ABD's which left only 2 before ABD stage. Candidates with or past ABD stage counted 95% of the candidates receiving conference interviews. Even though the model cannot explain the exact starting point for the candidate to begin their job search, the finding does encourage MIS candidates to do job search at their later stage.

The t-statistic for the months of teaching experience variable is -2.961, which is significant at the .01 level one-tail test. The coefficient (-0.0696) of the variable suggests that candidates received .07 less interview for every month of teaching or approximately one (.84) less interview for one year teaching experience. The small coefficient value should not discourage MIS candidates from pursuing teaching duties during their doctoral study. It does assert that candidates with excessive teaching experience have a lower chance of receiving plenty conference interviews.

Other interesting observations pertaining to the number of conference interviews is the lack of significance of many factors frequently reported to be meaningful in other related studies. For example, female candidates received almost 1.5 more interviews on average than their male counterparts, this sex discrimination variable is found to be statistically insignificant. Also, candidates with the U.S. citizenship fail to show a significant sign of receiving more interviews. Similarly, on average, married candidates had 2.14 more interviews than single or divorced candidates. However, this marital discrimination variable fails to show its significance. Even though candidates with MIS major obtained 2.3 more interviews than non-MIS candidates, the MIS major makes no significant result statistically.

Offer Possibility

The second regression model tests the relationship between the job offer and related explanatory factors. Explanatory variables such as female, number of conference proceedings, database management systems specialty and decision support systems specialty show a significant impact on job offer at .05 level (one-tail test) while candidate's program stage indicates a highly significant impact at .01 level. The dependent variable, job offer, is a binary variable of values 0 or 1. Therefore, the interpretation of those significant coefficients can be explained in percentage.

Female candidates had fourteen percent higher chance of receiving a position offer than their male contenders. One possible explanation for this sex discrimination is the result of many hiring institutions' efforts to hire minority and female faculty to comply with federal government policies in addition to monitoring compliance with EEOC rules. Administrators also need to fulfill AACSB's accreditation requirements (AACSB, 1985-6). The ratio of female faculty members to the male faculty members in the higher education currently is still lower than expected. Therefore, the trend of hiring more female faculty may continue for the next few years.

The candidate's current stage in the doctorate program is also a significant factor in determining his/her chance in job placement. Of the 60 candidates receiving job offer, 98.3% of them were at least ABD. Only one candidate (1.7%) was found to have just completed the course work. This finding suggests that the best time for doctoral candidates to join the job market is at their ABD stage.

Number of proceedings of candidates had a significant influence on receiving job offers. The coefficient (.046) indicates that candidates have roughly 5% more chance of receiving a job offer for each additional conference paper. However, surprisingly, no significant correlation was found between job offer and the number of journal publications. These findings suggest that many hiring institutions are still relying on conference papers to measure the candidate's research potential. However, it is expected that more institutions will place a heavier emphasis on journal publication record when assessing the candidates research capability.

Our study also indicated that candidates with DBMS and DSS specialization have better chances (33% and 32% respectively) to be placed in the job market. One possible explanation is that more schools are introducing DSS and database courses to their MIS programs. Therefore, the demand for MIS candidates with these two specializations shifted higher in the past two years. However, this phenomenon may be short-term. When demand direction changes, other MIS specializations may become more needed in the future job market.

CONCLUSIONS

This study provides comprehensive data on the new hire MIS market for 1992 and 1993. It is a continuous effort to study the MIS job market in academic environment. Important findings regarding MIS candidates' qualifications, research and teaching interest, and relevant factors affecting job placement were identified. Knowledge of these findings would be beneficial to MIS graduates attempting to join the job market. Information of the recent MIS academic market analysis will help MIS candidates maximize their opportunities and merits in job placement. Hiring institutions would also find this study beneficial when evaluating MIS candidates before making their offers.

MIS is still a young discipline. It is difficult now to predict with any certainty how the growth of this discipline will affect the supply and demand of MIS graduates. However, many researchers believe that progress in MIS partly hinges on the proper balance between the supply and demand for doctoral graduates. In computer science, annual market survey has been conducted to review the production and employment of Ph.D.'s and faculty. In accounting, academic survey and salary survey are conducted on a triennial basis. MIS researchers still have not yet performed any regular evaluation on the employment of their doctoral graduates. This study continues the research work on job survey in the MIS field.

To ensure a consistent review of MIS doctoral graduates and their employment, some part of the current survey might be replicated in future surveys. A longitudinal approach would prove beneficial in tracking historical development and identifying trends of future growth of the discipline. Researchers may even conduct a cross-disciplinary study to compare and analyze the performance of labor market, doctoral education, and salary structures of varied academic disciplines.

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Table 1. Teaching Experiences (in months)

	1992	1993
Full Time		
Mean	16.2	21.8
Standard Dev.	35.8	33.7
Maximum	156	135
Minimum	0	0
Part Time		
Mean	20.8	22.9
Standard Dev.	19.0	23.7
Maximum	72	120
Minimum	0	0

Table 2. Publication Record

1992

	Mean	Std.Dev.
Journal		
Published	1.05	3.15
Accepted	0.28	0.65
Reviewed	0.61	0.86
Proceeding		
Published	1.71	2.08
Accepted	0.27	0.58
Reviewed	0.30	0.70

1993

	Mean	Std.Dev.
Journal		
Published	1.28	3.11
Accepted	0.33	0.68
Reviewed	0.61	1.10
Proceeding		
Published	2.39	2.56
Accepted	0.11	0.43
Reviewed	0.22	0.58

Table 3. Salary Survey

1992

	9-month	12-month
Mean	50,220	57,000
Median	52,500	59,000
Std. Dev.	6,899	9,816
Maximum	60,000	72,111
Minimum	30,000	30,000
Responses	29	27

Table 3. Salary Survey (continued)

1993

	9-month	12-month
Mean	51,859	57,121
Median	53,500	59,500
Std. Dev.	8,953	11,347
Maximum	68,000	74,000
Minimum	20,000	20,000
Responses	27	27

Table 4. Job Selection Considerations

	1992	1993
Most important factors		
Friendliness of faculty	1	
Salary	2	5
Tenure and Promotion Requirement	3	
General quality of faculty	4	2
General quality of student	5	
Computer facilities of the school		1
Course load		3
Opportunity for joint faculty research		4
Least important factors		
Recreational facilities	20	
Fringe benefits	21	
Summer Support	22	
Cultural opportunities	23	
Consulting opportunities	24	20
Quality of school system		21
Educational opportunity for children		22
Career opportunity for spouse		23
Educational opportunity for spouse		24

Fuzzy Logic: An Introduction

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This tutorial is intended to give an overview of the concepts Fuzzy Logic and illustrate them with several examples using fuzzy logic. This tutorial is also intended to serve as an introduction into the study of Fuzzy Logic. Below is an outline of the tutorial. As of November 1, 1995 a brief annotated bibliography of books and articles to be used a as starting point for research into this area will be found at the Kansas Academy of Science world wide web home page in the CIS special interest group. The www location is: www.wuacc.kas.edu.

Fuzzy Logic Tutorial

I. Definition and Brief History of Fuzzy Logic

II. Fuzziness and Natural Language

III. Fuzziness and Certainty

IV. Need for Fuzzy Set Theory
- Fuzzy Sets vs Crisp Sets
  - Set Operations
    - On Crisp Sets
    - On Fuzzy Sets

V. Linguistic Variables

VI. Fuzzy Logic and Fuzzy Rules

VII. Fuzzy Reasoning using Fuzzy Rules
- Problem Solving Using Fuzzy Reasoning
- Examples of Fuzzy Reasoning

The Challenge of IT Education in Malaysia

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Abstract: Malaysia's prime minister has an aggressive development goal to be recognized as a fully developed economic entity by the year 2020. Leveraging information technology is a key to achieving this goal, but the nation's universities are not educating enough IT professionals to meet the private and public sector demand. The result for the education market is similar to the US situation in the 1960's and 1970's. This paper addresses the causes of the problem, and a proposal for the next steps to meet the challenge of preparing enough IT graduates to fill the jobs.

Introduction

Malaysia is one of the mini-dragons of southeast Asia and a rapidly growing economic presence quickly moving toward Newly Industrialized Country (NIC) status. The aggressive growth is fueled by the vision of the prime minister Mahathir bin Mohamad, who has initiated a national development goal of being recognized as a fully developed country by the year 2020 in a program called Wawasan (vision) 2020. Dr. Mahathir recognizes the critical role that information technology will play in reaching the goal. Leveraging the resources and energies of the country via information technology (IT) to leap frog through developmental stages is necessary to meet the needs of 1995 and onward. (Scientific American, 1994). Yet in 1995, The New Straits Times reported that the Malaysian society is less than 30% computer literate, pressuring educators.

The business sector has eagerly adopted IT to improve service delivery and manage information not only for Malaysia but all of SE Asia. Providing IT consulting services to lesser developed countries such as Vietnam and Laos, and in Africa, fuels the drive for IT hiring even more. The government has a shortage of qualified IT professionals to staff its work in process automation and service delivery improvements.

Market Demand for IT Professionals

In the private sector, the demands are increasing for qualified IT personnel especially in the area of telecommunications and consulting in south-east Asia. Wireless telecommunications is critical for transmitting information in areas with little wiring infrastructure and unstable power supplies. The New Straits Times reported 3500 vacant IT positions in private industry at the end of 1993.

30% of the over 2500 IT jobs unfilled in the federal government of Malaysia in 1995. The number of positions grew 18% in two years representing an increasing determination to utilize IT. The challenge is attracting qualified IT professionals with a lower pay scale than private industry can provide. The perquisites that civil service jobs provide is not sufficient to compete with higher pay in the private sector.

This lower pay scale also makes the staffing of IT teaching positions in national universities challenging. The difficulty in hiring male instructors has opened teaching opportunities for qualified women who are willing to trade the lower pay scale for time flexibility for family responsibilities. In one university, 9 out of 12 IT lecturer positions are filled by women. The Islamic fundamentalists in the government are encouraging women lecturers to leave the universities, but they don't have the answer for attracting male lecturers to the teaching spots.

Current Education

Malaysia has six national universities (and one international Islamic university) all with four year degrees in computer science or information technology, some graduate degrees but only one offers an MIS degree. The national universities instituted a racial quota system in 1971 under the New Economic Policy that limited the number of Chinese students admitted to 35% and Indian students to 15%, leaving 50% of the spots for bumiputera (native Malays). Prior to these quotas, the students were 90% Chinese based on admissions criteria of a STPM certificate, an O level credit in Bahasa Malay and high A level grades. Only 36% of the university applicants were admitted in 1988. (Ghani, 1990, The Economist, 1994).

The disenfranchised Chinese and Indian students have flocked to take degrees in other countries as well as to "twinning", "branch campus", and "joint degree" programs. Twining schemes are co-operative agreements between junior colleges in Malaysia and baccalaureate universities in Australia, New Zealand, UK, Canada, US and other countries. The students take their first two years of study in Malaysia, then finish their studies abroad (thus saving money by living with their families until they are older.) The number of twinning programs has grown from 66 in 1990 to 118 in 1995 9 of which are IT related degrees with more increases expected. Chinese students make up 80% of the students in these programs, with the rest split evenly between Indian and bumiputera Malays. (Ghani, 1990).

In 1987, 68,000 Malaysian students were estimated to be studying abroad, primarily in the UK, USA, Canada, Australia and India, three times the number in 1970. (Ghani, 1990). English is the language of commerce in Malaysia and English proficiency is desired. Some of the countries also have open immigration policies. Also, the Islamic fundamentalists in the Malaysian government have mandated that university instruction has to be conducted in Bahasa Malay despite using textbooks written in English. The private sector is not supportive of this edict as they need students fluent in English for work.

University degrees earned outside of Malaysia have greater socia and ecomonic prestige and are perceived to be more valuable due a variety of factors, not the least of which is the improved English skills and social networks. Malaysian teaching styles rely on rote memorization as opposed to western teaching styles that utilize student and teacher interaction and questioning. The improved marketability of the graduates increases the opporunities for emigration for the student and their families. Instutionalized discrimination in favor of the male bumiputera in hiring and promotion practices in Malaysia provide incentives for women and non-Bumiputera to seek better opportunities outside of Malaysia. (Lee, 1982).

The 1993 Annual Federal Accomplishments Report of the Civil Service of Malaysia cited a total of 1039 IT degrees granted by Malaysian universities, up 19% from 1992. Only 21 of the degrees were at the graduate level, and only 1 a doctorate. The aggregate number is subtantial but doesn't begin to meet the demands of industry and government. Malaysian university IT degree programs do not conform to US curriculum standards (either ACM or DPMA).

With a limited number of Malaysian university spots available for Chinese and Indian students, as well the additional costs to study overseas, the demand for local education has been filled by private colleges and schools that offer business, IT and other certificates, diplomas and degrees. 98 of the 213 private schools offer IT/IS diplomas and certificates according the National Ministry of Education.

The private institutions are not closely regulated by the Malaysian government, and there are few curricular or achievement standards for the schools or the graduates. The private institutions have formulated their own standards and accreditation criteria via NAPIEI (National Association of Private and Independent Educational Institutions) but they don't address communications, problem formulating and decision making skills. The Ministry of Education grants licenses and registrations, but is not staffed sufficiently to monitor the private school curricula.

The private education market is open to any entrepreneur who wants to start a school and make money. The staffing of the teaching spots is often done by importing recent computer curriculum graduates from other countries where job markets are saturated. The private school curricula and hardware can be outdated and the instructor's credentials questionable, but the students are not in a position to evaluate this until after they enter the job market.

Current Situation

Students are attracted to the private schools for entry qualifications into lucrative, high demand careers, but have no assurance that the training they receive is adequate preparation for the jobs they seek. The national universities are producing graduates without adequate English skills. When hiring individuals in entry level positions, the employers have the dilemma of attempting to assess the qualifications of each applicant without an accepted standard of measurement of a candidate's abilities or potential. This situation is congruent with the US and Europe in the 1960's and 1970's. The first university MIS program in the US was at the University of Minnesota in 1971 and only a few schools offered computer science degrees. Private schools sprang up daily and were filled with returning Vietnam vets and others eager to get into the exciting world of data processing. Employers created on-the-job training programs with varying degrees of success.

Certification tests were offered by several professional groups for programmers and analysts who had learned "on-the-job" and lacked the four year university degree qualifications. Unfortuneately continuing re-testing for currency of knowledge was not a requirement, negating their value over time. The usefulness of the certificates is hotly debated and both ACM and IEEE are reviewing them currently. (Betts, 1994, Gotternbarn and Webber, 1994).

In response to the industry demands for quality, model curricula were jointly created by practioners and academics and adopted by the professional societies, as well as codes of ethics. More universities offered MIS and CIS degrees, based on the model curricula and private schools dwindled dramatically.

Conclusion

Malaysia can learn from the experiences of the west in dealing with a growth economy demanding more IT graduates with current skills than the universities and other institutions can provide. The market demand for qualified IT practitioners will keep salaries inflated as long as the supply of qualified graduates is limited.

Standardized information systems skills certification tests can provide a short term solution to provide employers with some assurance of individual's capability until model curricula can be established and adopted, and more controls exerted over private school licensing. One US certifying group, AIICP, doesn't offer testing in

Malaysia now, but is willing to do so with controlled monitoring. Certification will open the market for preparatory and refresher continuing education seminars.

Employers will have to develop a multiple pronged approach to retention and recruitment. A focus on better employee retention via skill retraining, as well as design competitive compensation packages. Recruiting may have to come from other countries where job demand is shrinking or via internship programs with universities. Providing scholarship funds for university study and certification testing will provide a valued employee benefit.

The supply of students for twining programs and private institutions will continue to increase as long as the government dictates university instruction in Bahasa Malay, enforces strict racial quotas for admissions and discourages women from being lecturers. Universities may have to increase the number of visiting scholars to teach in English, or use contract instructors to fill the ranks.

The disparity of the business and government pay scales will increase until the supply of IT professionals increases. This will mean that the government will have to employ more creative strategies to obtain the IT expertise it needs to achieve Wawasan 2020. These will include outsourcing, use of consultants, better compensation packages for IT, aggressive recruiting tactics emphasizing non-monetary benefits of the civil service and retraining of current civil service employees into skilled IT professionals.

Malaysia is not the first economy to experience this dilemma, and can effectively leverage their actions from the experiences of other countries that have gone through similar situations.

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IMPORTANCE OF SELECTED COMPETENCIES AND SKILLS
IN BUSINESS INFORMATION SYSTEMS
AS PERCEIVED BY BIS GRADUATES

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Abstract

Information about entry-level job requirements for information systems graduates was obtained from a survey of university graduates of the business information systems program. Each of the 229 graduates was asked to evaluate the importance of eighteen information systems topics being considered for curriculum revision. Usable returns were received from 136 graduates for a response rate of 59.4 percent.

Based on present job title, the respondents were divided into three categories: programmer/analyst, other computer-related positions reporting to the IS Department, and positions that were not related to computers. The data were analyzed to identify those topics perceived as most important and those perceived as not being important. Over 50 percent of the programmer/analysts and those in other computer-related positions believe 15 of the 18 items to be either important or extremely important. The difference between the two groups was statistically significant for only two of the topics.

Most of the 136 respondents are employed in a geographic triangle from Harrisburg to Philadelphia to Washington, D. C., an area which includes organizations in the Fortune 500 as well as smaller companies and government agencies. Therefore, the findings of this recent study will be of value to other colleges and universities as a checklist for curriculum revision and as a reference for conducting a similar survey.

Introduction

The demand for information system specialists continues to grow and is predicted to continue expanding for the next five to ten years. The Bureau of Labor Statistics predicts a 79 percent increase in the number of computer system analysts by the year 2005 (OCCUPATIONAL OUTLOOK QUARTERLY, 1992). This figure does not include the growth for other information system professionals such as application programmers, end user support personnel, database specialists, or network support personnel. Therefore, the need for professionals in information systems creates numerous career opportunities for college graduates of business information systems programs.

This promising career field can be entered only if the graduates have attained the skills and knowledge needed by personnel in these positions. However, designing a curriculum to develop these skills and this knowledge presents a tremendous challenge to college and university faculty for several reasons.

First, IS departments have varied expectations of new employees. Many employers seek entry-level employees who can contribute immediately to their IS development projects as the demands upon their IS staff are overwhelming. This means that new employees must be knowledgeable in current methodologies and have acquired usable skills. At the same time some employers expect the new personnel to help them implement and adapt to new methods offered by emerging technologies. In addition, the students need a foundation for career development as the technology changes and/or as the individual advances to new levels of responsibility.

Secondly, IS technology is developing and changing so rapidly, it is extremely difficult for faculty to provide a curriculum which addresses all technical expectations of business. Time is required for new ideas and technologies to shakedown and for trends to evolve. If faculty move too rapidly in adopting new ideas, they can invest time and money in a methodology that might not be utilized by the business community. On the other hand, a long delay in incorporating new trends may not prepare the students for existing job demands.

Third, once faculty have designed a relevant curriculum, there is usually another delay until funds are available for needed resources to implement it. Thus, there is a time gap between acceptance of a technology by business and inclusion in the college/university curriculum.

Because of these factors, business information systems faculty need to monitor developments in the industry and the ever-changing demands of the business community and to constantly assess their curriculum in view of these needs.

Faculty can employ several methods to keep abreast of the needs and demands of business. They can read trade publications and attend professional conferences to learn what industry experts are predicting, and they can read academic journals to learn the results of research.

In addition, faculty need to be cognizant of business needs in the geographic area where most of their graduates seek employment. Valuable insight on regional needs can be gained by faculty interaction with employers of interns, recruiters of graduates, and graduates of the program.

For the last several years the IS faculty at Shippensburg University have been examining their curriculum to determine what adjustments need to be made for today's job market. They have been employing all of these strategies to become knowledgeable about the information system needs of business. Studies showed that basic knowledge of business, general knowledge of information systems, people skills, and communication skills are important (Nelson, 1991; Eierman and Schultz, 1994; Niederman, Branchman, and Wetherbe, 1991; and Leitheiser, 1992). Such research has provided valuable input for aspects of the curriculum designed to develop foundation knowledge and to further career development. Other studies identified technical skills required for entry-level employment such as programming languages, operating systems, and database applications (Trauth, 1993; Prahbaker, Litesky, and Arnett, 1995; and Eierman, 1994).

However, the faculty believed that additional timely regional information about entry-level requisite skills was needed before finalizing their curriculum modifications. To supplement the existing information, they conducted a survey of business information system graduates.

Methodology

The faculty compiled a list of eighteen topics being considered for (1) inclusion, (2) increased emphasis, or (3) a reduction in emphasis. Graduates were asked to rate the value of each item for entry-level information processing positions five years from now. Each item was to be rated as extremely important, important, slightly important, or irrelevant. Space was provided for comments regarding each item as well as for the graduates to add items to the list under **Other.**

In the fall of 1994 the survey instrument was sent to the 229 graduates of the Business Information Systems major, all of whom had graduated between 1982, when the program was initiated, and 1994. There were 149 questionnaires returned for a response rate of 65 percent; however, only 136, or 59.4 percent of the mailed surveys, were complete and usable. (A copy of the survey instrument will be available from the author.)

The 136 usable responses included 61 males and 75 females. Approximately one-third (43 or 31.6%) were employed as programmer/analyst, about half (71 or 52.2%) were employed in other computer-related positions reporting to the information systems department of the organization, and about one-sixth (22 or 16.2%) had moved into positions that did not report to the IS department.

Most of these respondents were employed in a geographic triangle from Harrisburg to Philadelphia to Washington, D. C. The employing organizations represent small organizations as well as Fortune 500 companies, profit and nonprofit organizations, and manufacturing as well as service industries.

Findings

Based on their present position, the respondents were divided into three categories for analysis:

Programmer/analyst - individuals whose job title was programmer, analyst, or programmer/analyst

Other computer-related positions - individuals who indicated they report to the information systems department of the organization but who were not in the programmer/analyst category

Not computer-related positions - although these individuals may be end users, they do not report to the information systems department and their job titles do not reflect information systems responsibilities.

All of the items in the survey and the number of respondents in each job category who rated the item as important or extremely important are presented in Table 1.

The top ten items were the same for programmer/analysts as for other computer-related positions. However, the rank order differed slightly but not enough to be statistically significant.

Also Table 1 shows that 15 of the topics were rated as important or very important by more than 50 percent of the programmer/analysts and by individuals in other computer-related positions. Although 53.3 percent of those employed in other computer-related positions viewed prototyping and/or RAD as important or extremely important, only 37.2 percent of the programmer/analysts viewed it that way. The only item which less than half of both groups rated as important or very important was artificial intelligence/expert systems.

The rank order of the items by the graduates in noncomputer-related positions deviated markedly from the other two categories. The high ranking of spreadsheets and graphics was expected as these are applications frequently used by persons outside of the IS department. Likewise, the omission of C from the top list seems logical as these individuals are not programmers.

Chi-square tests show that current job position, programmer/analyst or other computer-related positions, significantly affects the view of the respondents on only two items: COBOL and Artificial Intelligence/Expert Systems. Table 2 shows that programmer/analysts think COBOL is more important than persons in other computer-related positions; conversely, graduates in other computer-related positions view artificial intelligence/expert systems as more important.

Table 3 presents the seven items rated as extremely important by the programmer/analysts and persons in other computer-related positions. The same items are in the top seven for both groups, but with a slightly different percent viewing them as extremely important. The two most noticeable shifts were the increased number of persons in other computer-related positions who rated Windows and business analysis as extremely important.

Before 1990 Business Information Systems graduates at Shippensburg University were required to complete Business Communications and Computer Programming I (Fortran). Beginning in 1990, these requirements were replaced by Database Applications and Computer Systems

Concepts (a hardware course). A chi-square test was conducted to determine if year of graduation, 1982-1989 versus 1990-1994, affected the ranking of the 18 topics. The 1990-1994 graduates view C and UNIX as more important and Business Analysis as less important than the 1982-1989 graduates. The ratings on the other 15 items were not statistically significant. Table 4 presents the difference for these three items for persons graduating 1982 through 1989 and those persons graduating from 1990 through 1994.

Data were also tested for a significant difference between present position and year of graduation (before 1990 or after 1990). There was no statistically significant difference.

Space had been provided beside each of the 18 items for comments by the respondents, but most of them did not comment. In addition, at the bottom of the list were several blanks for items to be inserted by the graduates. The skills that were mentioned by two or more persons were: Visual Basic, JCL, PowerBuilder, C++, and FoxPro.

Conclusions

The findings of this study support the belief of the faculty that all of the items in the survey need to be included in some manner in the preparation of business information systems majors. Windows, networking, and relational database were rated as important or extremely important by over 90 percent of the graduates employed in information systems departments. Most information systems faculty are already integrating these topics into their curriculums. The fourth item, client/server architecture, is a newer technology, and it is one which is having a revolutionary effect on information systems. Consequently, it is an essential component for any curriculum to prepare students for the present as well as the future information needs of business organizations.

The only two items included in this survey which were not technical skills were business analysis (understanding business processes and how they can be improved) and project management. Both were rated as important or very important by over 85 percent of the respondents employed by information systems departments. Understanding business concepts and procedures is what makes the business information systems major unique from other computer curriculums. Therefore, courses which provide this knowledge must be an important component of the curriculum.

Although many college/university faculty have been questioning the time devoted to COBOL, the graduates indicated that they believe it will continue to be a valuable skill in the immediate future. Therefore, COBOL needs to be a part of the IS curriculum. However, COBOL courses can incorporate a knowledge of object-oriented technologies, the UNIX operating system, and CASE tools. If faculty design courses which integrate these topics into a cohesive unit, these courses can provide a basic knowledge of programming development skills and concepts.

The importance of connectivity is reflected by the high ratings placed upon networking, client/server architecture, and information services. The dramatic increase in availability of the Internet to the academic community enables faculty to include information services and to provide students with an excellent example of the benefits to be gained by telecommunications technology.

Artificial intelligence/expert systems and prototyping were the items receiving the lowest number of important ratings. These are emerging technologies, not ebbing ones; therefore, they need to be included in the curriculum.

The items included in this study need to be incorporated into an IS curriculum for business students; however the curriculum should not be limited to these skills. First, the skills in this study do not necessarily represent all of the technical skills graduates will need at the present time or in the near future. Secondly, except for business analysis and project management, the study did not include background topics or concepts which have been identified in other research. Such background areas include communication skills, personal skills, and general IS concepts.

Although the respondents in this study were employed primarily in the area between Philadelphia, Washington, and Harrisburg, this area includes organizations of various types and sizes with a broad spectrum of IS needs. Faculty in all sections of the country can use it as one checklist for curriculum evaluation. Also, they can use it as a reference for conducting a similar survey of their information systems graduates.

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Table 1
PERCENT OF RESPONDENTS BY JOB CATEGORY RATING ITEM AS IMPORTANT OR EXTREMELY IMPORTANT

	Programmer Analyst N=43	Other Computer Related N=71	Not Computer Related N=22
Windows	97.7%	92.9%	95.5%
Networking (LAN, WAN, etc.)	95.4%	95.8%	86.4%
Database--Relational	95.3%	95.8%	86.4%
Client/Server Architecture	90.7%	91.5%	59.1%
Business Analysis (understanding business processes and how they can be improved)	88.4%	87.3%	68.2%
Project Management	86.1%	84.5%	72.7%
SQL	81.4%	86.0%	59.1%
C Language	79.1%	74.6%	54.5%
Information Services e.g. Internet	76.8%	74.7%	68.2%
Object-oriented Technologies	72.1%	78.9%	59.1%
UNIX	69.8%	73.3%	31.8%
Microcomputer Software Integration Techniques e.g. OLE	62.8%	67.6%	45.5%
COBOL Language	62.8%	53.6%	40.9%
Spreadsheets	58.2%	57.7%	86.4%
Presentation Graphics	58.1%	46.5%	86.4%
CASE Tools	53.5%	53.6%	36.4%
Artificial Intelligence/Expert Systems	48.8%	47.9%	45.5%
Prototyping and/or RAD	37.2%	53.5%	13.6%

Table 2
DIFFERENCE IN RESPONSES FOR
PROGRAMMER/ANALYSTS AND OTHER COMPUTER-RELATED POSITIONS
FOR COBOL AND ARTIFICIAL INTELLIGENCE/EXPERT SYSTEMS

	COBOL		Artificial Intelligence	
	Programmer	Computer Related	Programmer	Computer Related
Extremely Important	23.3%	8.5%	2.3%	16.9%
Important	39.5%	45.1%	46.5%	31.0%
Slightly important	34.9%	33.8%	41.9%	45.1%
Irrelevant	2.3%	12.7%	9.3%	7.0%

Table 3
PERCENT OF PROGRAMMER/ANALYSTS
AND PERSONS IN OTHER COMPUTER-RELATED POSITIONS
RATING ITEM AS EXTREMELY IMPORTANT

	Programmer Analyst N=43	Other Computer Related N=71
Client/Server Architecture	72.1%	71.8%
Networking (LAN, WAN, etc.)	72.1%	69.0%
Database--Relational	67.4%	53.5%
Windows	60.5%	71.8%
SQL	51.2%	43.7%
Project Management	44.2%	39.4%
Business Analysis	44.2%	56.3%

Table 4
DIFFERENCE IN RESPONSES OF GRADUATES
BEFORE 1990 AND AFTER 1990 FOR
UNIX, C, AND BUSINESS ANALYSIS

	UNIX		C		BUSINESS ANALYSIS	
	1989 or Before	After 1989	1989 or Before	After 1989	1989 or Before	After 1989
Extremely Important	24.4%	30.4%	21.1%	45.7%	60.0%	30.4%
Important	32.2%	52.2%	44.4%	41.3%	26.7%	50.0%
Slightly important	24.4%	10.9%	18.9%	6.5%	11.1%	17.4%
Irrelevant	18.9%	6.5%	15.6%	6.5%	2.2%	2.2%

Competitive Intelligence in Information Systems Classes?

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ABSTRACT

From a nationwide study of strategic business units in the pharmaceutical industry exploring the antecedents and consequences of competitive intelligence, an interesting relationship was observed between CI activities and the use of information technology (Wee, 1992). The purpose of this paper is to (1) discuss the importance of competitive intelligence in the business community, (2) illustrate the relationship between competitive intelligence and information technology, and (3) encourage the discussion of introducing competitive intelligence issues in information systems education. A questionnaire survey was done with 154 strategic business units ranging in sales from less than $1 million to over $8 billion. Responses were received from 103 strategic business units, giving us the response rate of 67%. One of the findings showed that the presence of CI activities is a predictor of the use of IT tools. If our information systems students are expected to provide support for business solutions to their future employers, do we need to help them acquire a more proactive attitude and understand the importance of CI in their employers' decision making process?

WHAT IS COMPETITIVE INTELLIGENCE?

Competitive Intelligence (CI) refers to "the ethical gathering and use of publicly or semi-publicly available information" (Gilad, 1988) about trends, events, or players outside a firm's official boundaries. In different contexts, CI can mean both the process involved and the intelligence gathered by means of the process. Specifically, the process is a "method for identifying the CI requirements of a company, systematically collecting relevant information on competitors, and then analytically processing that raw data into actionable knowledge about competitors' strategic capabilities, position, performance, and intentions" (Sammon et al, 1984). The end product of CI is "processed information of interest to management about the present and future environment in which the business is operating" (Greene, 1966) that would assist top management in its task for formulating strategy and making long-range plans (Aguilar, 1967).

PAST RESEARCH AND IMPLICATIONS

Corporate survival requires both an orientation to the present and an orientation to the future. Nanus (1975) suggests that the former is necessary for "stability and continuity," and the latter for "change and adaptability." The work of Michael Porter (1980) strongly suggests to top management that CI is a central component of competitive strategy. Top decision makers should make decisions with a full awareness of their competitive business environment. A key precept of CI is that "90 percent of the information that any business needs to make key decisions about itself and to understand its market and competitors is in the public record or can be developed from data already there" (Vella and McGonagle, 1988). Gilad (1991) and others (Aguilar, 1967;

Fahey and King, 1977; Kahalas et al., 1976; Segev, 1977; Webber, 1974) have concluded that the difference between a "well-backed decision" and one that ignores CI can be so disastrous that top management should be continuously concerned with the effectiveness of CI activities.

Since 1979, 40 percent of companies in the Fortune 500 have been dropped from the listing (Gilad, 1991). Strong CI support for top decision makers is long overdue and is a necessity in today's competitive environment. Aguilar (1967) found in his study that management's understanding of CI activities was generally inadequate. His findings were supported by subsequent studies (Fahey and King, 1977; Stubbart, 1982; Lenz and Engledow, 1986). So far, little research has been done to examine the "structures and process" of CI activities in organizations (Ghoshal and Westney, 1991). Research in this area is important because it will help identify the critical factors under management control that can be influenced to enhance CI activities.

The findings from our survey indicate that the existence of a champion of CI activities ($\beta=.55$, $p<.001$) and top management support for CI activities ($\beta=0.55$, $p<.001$) are very strong predictors of the extent of CI activities. In turn, the extent of CI activities predict the strategic business units' (SBUs) level of knowledge of their external environment ($\beta=.45$, $p<.001$), the relationships among the corporate functions within the SBU ($\beta=.22$, $p<.05$), and the SBUs' confidence in their strategic plans ($\beta=.34$, $p<.001$).

Question: *If CI is important to corporate decision makers, how would IS personnel support their needs?*

In terms of implementation, CI activities should be done on a continuous basis partly because CI does not arrive all at once. Rather, CI must be put together over a period of time to yield a comprehensive picture of the environment (Porter, 1980). Why should assessment of the external business environment be an explicit task in the corporate planning process? According to Klein and Linneman (1984), there are two primary reasons. First, over the last decade, there is emerging interest in and practice of formalized strategic planning. All contemporary strategic planning systems begin with systematic attention to developments outside the firm's boundaries (e.g., Day, 1984; Sammon et al., 1984). This attention enables firms to (1) match business plans with environmental developments (Narchal, et al., 1987), (2) improve strategic decision-making by uncovering the actual and potential intentions of key competitors (Vella and McGonagle, 1987), and (3) develop structures that allow for a match between internal structures and external developments (Lawrence and Lorsh, 1986). Therefore, by their very nature, CI activities should be strategically motivated. The CI activities' end-product feeds directly into the strategic planning process of the organization (Grant and King, 1982; Vella and McGonagle, 1988).

Second, the corporate external environment is increasing in complexity and instability. Terry (1977) suggests that CI activities help focus managers' attention on what lies outside the organization and encourage creation of an organization which can adapt to and learn from the environment. Mintzberg (1973) states that one of the functions of managers is to monitor. This requires managers to develop a thorough understanding of both the organization and the external environment. Managers must gather information about his/her organization's strengths and weaknesses in order to assess what is needed to make the organization better.

From our subsequent analysis, the SBUs' knowledge of their external environment ($\beta=0.37$, $p<.01$) and the SBUs' product quality ($\beta=.41$, $p<.001$) are strong predictors of the SBUs' business performance. Hence, given that the extent of CI activities predicts environmental knowledge, we speculate that knowledge of external environment and product quality may be mediators between the extent of CI activities and the SBUs' business performance.

Question: *In order to fully understand how to support the corporate decision makers' need for CI, should we not expose our IS students to CI issues?*

INFORMATION TECHNOLOGY

Based on the literature review discussed below, we proposed the following hypothesis in our research proposal:

H: *The greater the use of IT tools, the greater the extent of CI activities.*

Keegan's (1974) study of the corporate information sources utilized by executives illustrated that computer-based information systems were not found and manual systems were insignificant as factors in day-to-day information gathering. Furthermore, Neubauer and Soloman (1977) also found that the tools to monitor the environment were relatively underdeveloped. The study done by Fahey et al., (1981) supported the conclusion that organizations had not yet widely developed sophisticated CI gathering systems. Nowadays, however, more managers who are non-information systems personnel are involved in the shaping of information systems' direction. These managers are taking the initiative in applying IT to the most important areas of their business (Rockart, 1988).

In the last decade, many articles (Benjamin et al., 1984; Clemons and Knez, 1988; Feeny and Ives, 1990; Gerstein and Reisman, 1982; McFarlan, 1984; Parsons, 1983; Porter and Millar, 1985; Rackoff, 1985; Straub and Wetherbe, 1989) and books (Keen, 1986; Roukis et al., 1990; Synott, 1987; Vella and McGonagle, 1987; Wiseman, 1981) called to attention a new competitive weapon - Information Technology (IT). Today, CI activities must cope with the changing reality produced by IT.

In their study, Brancheau and Wetherby (1987) asked chief information systems executives to identify major IT issues likely to be of concern to them three to five years into the future. A few of the top issues identified were: (1) using IT for competitive advantage, (2) increasing understanding of the role and contribution of IT, (3) facilitating organizational learning and use of IT, and (4) promoting effective use of information resources. Another study by Hartog and Herbert (1986) yielded similar findings.

Sawy (1985) wrote of the "tempo of business" becoming faster with "changes in technology and speedier communications making the time span of important changes critical." In fact, Main (1988) observed that, "More than being helped by computers, companies will live by them, shaping strategy and structure to fit new information technology." Hence, corporate executives should view "IT as a source of change, and as a tool for strategic positioning" for the organization (Clemons and Weber, 1990). Furthermore, the finding of Straub and Whetherbe (1989) suggested that "strategic planning by top management must take into account ways that IT can revolutionize internal procedures and practices."

The increasing competitive impact of IT has made it a new concern for senior management. In fact, organizations are now creating high profile IT investigatory divisions to keep them abreast of technology and innovation (Zmud, 1984). Efficient and effective IT "will be crucial for meeting the challenge of organizational prosperity in the 1990s and early 2000s" (Straub and Wetherbe, 1989).

In the past, IT was used to obtain mostly internal or company-specific information such as sales, financial performance, inventory, payroll record and so on (McGrane, 1987). The challenge facing all major organizations today is to maximize the usefulness of their own internal marketing information and data. The realization has dawned that stored data can be converted into valuable market-oriented intelligence.

Communications and IT have radically affected the area of CI activities. Today, more and more corporate intelligence analysts are relying on outside database services for current information on industry trends and competitors' financial performance. The role of telecommunications and database infrastructure in contributing to strategic applications have been studied by many (Clemons and McFarlan, 1986; Madnick and Wang, 1988). The real benefit will come from "giving knowledge workers direct and immediate access to both formal and informal knowledge that they never had before" (Straub and Whetherbe, 1989). The exciting thing about information is that it creates change. In practice, information has value in direct proportion to what is at stake in a decision. Information directed at decisions becomes a part of the decision process and contributes critical value.

IT affects many aspects of a company's operations and has become a critical enabler of many business strategies (Clemons and Weber, 1990). IT can enable other resources controlled by the company to be exploited to advantage (Clemons and Row, 1987). Straub and Whetherbe (1989) have suggested that "information transfer between organizations and democratization of the accessibility of information within organizations will reach unprecedented levels." In McGrane's study (1987), he found that most managers spend a significant part of their time gathering outside information, and 20 to 50 percent of their time analyzing it.

Huber (1984) argued that organizations in the 1990s will be under enormous pressure to handle information efficiently and effectively. Dramatic increases in the intensity of competitive forces, shortened production cycles for new products and services, and huge volumes are readily available information are some elements in the business environment that will make IT invaluable. In fact, organizations that do not manage the transition from "an industrial orientation to an information orientation will very likely suffer extinction." Management which understands the potential benefits of IT and takes steps to implement IT will be able to respond more proactively to the expected turbulence of the 1990s (Straub and Whetherbe, 1989).

Despite "corporate performance dips and anxiety about the future," Sullivan-Trainor and Maglitta (1990) have reported that many successful organizations continue to be committed to IT because it has helped them avoid various "business booby traps." In short, organizational survival will be even more at stake in the future than it has been in the past and IT will play a crucial role in the process.

Top information systems executives have expressed the sentiment that their organizations are counting on IT more than ever before to "shore up and even expand their businesses" (Sullivan-Trainor and Maglitta, 1990). To expand, an organization must evaluate the potential threats and opportunities involved in strategic moves. CI activities will be needed. Information is the key ingredients in modern corporate CI activities. The sheer volume of such information would make it unmanageable without the help of computer technology (Conway, 1990; Vella and MaGonagle, 1988).

Contrary to our previously stated hypothesis, analysis of the data suggests that instead of being an antecedent variable, the use of IT tools may be a consequence variable. The hypothesis was not supported. However, if we were to reverse the hypothesis, namely the greater the extent of CI activities, the greater the use of IT tools, we find an interesting result. We found that the presence of CI activities in a business unit is a predictor of the use of IT tools (β = .23, p <.05)

Question: *If the extent of CI activities predicts the use of IT tools* *in the pharmaceutical SBUs, is this relation valid in other industries?*

Question: *Is the relationship between CI activities and IT critical knowledge to our IS students?*

Question: *If we do introduce CI issues to our IS students, how should we incorporate them into our IS curriculum?*

Question: *How do we measure the value added to our IS students' education and skills by exposing them to CI issues?*

METHODOLOGY

The data of our survey were collected using a procedure adapted from Dillman (1978) to ensure a high response rate. The research methodology used involved a nation-wide questionnaire survey. The sample consisted of 154 pharmaceutical strategic business units (SBUs) selected from the Ward's Business Directory of U.S. Private and Public Companies - 1992. The response rate was 67 percent. This enabled us to have adequate confidence in the testing of the hypotheses and the results obtained after analysis. The positions held by the sample respondents were:

VP of Marketing/Sales	30.2%
Director of Marketing/Sales	27.5%
Market Research	14.3%
Business/Strategic Information Analyst	6.5%
Director of Market Research	6.0%
Director of Strategy/Business Development	5.0%
Other positions (e.g., VP of Operations, President, General Manager, CFO)	10.5%

In terms of SBU sales, there was considerable variance. The median figure was $70 million (N = 97), the low was $1 million and the high was $8.93 billion. Among the SBUs sampled:

$0 to $50 million	45.3%
$250 to $500 million	10.3%
$50 to $100 million	12.4%
$500 to $1 billion	1.0%
$100 to $150 million	13.4%
$1 to $5 billion	10.0%
$150 to $250 million	6.2%
Over $5 billion	2.1%

CONCLUSION

As stated earlier, one of the purposes of the paper is to stimulate discussion on whether CI issues have a role to play in IS education.

Since our IS students are expected to provide business solutions to satisfy corporate decision makers' information needs, operating in this competitive global business arena, the impact of CI on strategic decision making is enormous.

We have experimented with an "Introduction to Competitive Intelligence" course twice during the 1993 and 1994 January-term. The course focuses mainly on CI concepts and issues. The students are required to do a CI-related project during that month-long course. The 1993 students did a questionnaire survey of local businesses on the importance of CI in their decision making processes. The 1994 students did a campus survey to assess the current IT support provided by the college and future IT needs. An average of 20 students enrolled in the course, and the feedback has been very positive. Some said the course widened their perspectives on decision making, many said they had never realized the significance of CI before, and others decided to take a more proactive approach towards their remaining college education.

Our feeling is that our IS students need to be proactive and understand the need for CI by corporate decision makers. With that understanding, the quality and usefulness of their business solutions they provide will improve. We want to find out if other IS educators also view CI issues as an important and worthwhile component in the IS curriculum? If they are, where do we begin? How do we measure the value added? And what is the short-term and long-term impact on our IS curriculum?

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Will CASE Tools Take the Jobs of Systems Developers?

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PAPER NOT AVAILABLE AT PRESS TIME

ELECTRONIC QUESTIONNAIRES AND SURVEYS
A COMPUTER LANGUAGE-BASED METHOD

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ABSTRACT

Markup languages are becoming widely used in the formatting and processing of text, especially with the increased interest in electronic publishing, and the Internet. Descriptive markup is of particular importance, because it allows a description of a document or text element which is independent of its final form and output. The creation of survey questionnaires is an important and widely-used application in the area of text processing, and an important component of any markup language standard should be the inclusion of markups for survey question types. This paper presents the design of descriptive markup functions to support the survey application and to extend the utility of the markup approach. It proposes markups which should serve as an extension to existing markup standards. The benefits of markup command-language methods as opposed to standard direct-manipulation WYSIWYG approaches is also discussed.

OVERVIEW

Surveys are the cornerstones of behavioral and social science research, as well as an important part of information systems research. They are also widely used for marketing research, such as to obtain opinions and buying preferences about products and services. Surveys are also used to gather data on attitudes, beliefs, preferences, and choices between various options. Questionnaires are an important method for conducting these surveys. Usually, a survey questionnaire would contain a variety of question types, such as Likert, semantic differential, free response, multiple choice, rank ordering, and others.

The "traditional" method of creating questionnaires is to plan out the questions on paper, and then type them out on a typewriter or word processor. The creation of an entire survey therefore takes a great deal of time if you consider the various steps of designing, typing, formatting, and editing. These paper surveys are then administered manually, by asking subjects to fill in these paper questionnaires, which are then submitted back to the survey administrator for data collection and analysis.

Creation of survey questionnaires this manual way is cumbersome and slow. A lot of time is spent on the formatting and presentation of the questions when they are created and typed, instead of focusing only on the content of the questions and the overall objective of the survey. The "traditional" method of survey questionnaire design could be referred to as the "direct manipulation" or WYSIWYG (What You See Is What You Get) approach.

The main objective of this effort was to design a set of markups which provides an easier means for creating survey questionnaires, not only paper survey printouts but also automated online surveys. A command language (markup language) approach is used as opposed to the direct manipulation, WYSIWYG approach. While WYSIWYG approaches are generally well suited to novice users, the command language approach often brings about greater efficiency and productivity, especially for more experienced users who possess a good knowledge of an application such as the creation and design of survey questionnaires. From the viewpoint of practical use, the survey markup language designed here is designed to be easy to use. You need merely to select the question type (element) and then indicate the text and other specifications about the question to be created.

Before proceeding further, it would be useful to define what markups are. Markups are sets of tags, tokens, characters, or specialized commands which are placed into a body of text in order to provide information about the text or other data being processed. A markup could be as simple as a space or line feed, or a complex set of symbols for setting all the formatting details for a text document (Coombs et al., 1987; Goldfarb, 1981; Wright, 1992). Markups enable one to "unlock" the data content of a document. In other words, a document is not just a stream of characters, but rather is a data structure which encompasses a great deal of content (Cronk, 1993; Goldfarb, 1991; Van Herwigen et al. 1990). The concept of a markup is simple--whenever you write something, you also "mark it up." Markups can be used to specify the boundaries between words, sentences, and paragraphs, and also indicate the typographical and structural features of a text, such as chapter headings, titles, and indented sections. Some forms of markup allow one to specify the various components of a specific document type, whether it be a book, article, or paper. There are several different kinds of markup which are used.
One commonly used form of markup is punctuational markup. This basically involves adding punctuation to the text, such as commas, periods, question marks, and exclamation points (Coombs et al, 1987).
Presentational Markup is another widely used form, which uses formatting commands to enhance the presentation of text. For instance, horizontal and vertical spacing, underlining, indenting, and page breaks are added directly into the text to make it more understandable and easy to read.
Presentational markup clarifies presentation of the text (Coombs et al, 1987).

Procedural Markup is another form of markup where commands placed in the text indicate how text should be formatted. Basically, it provides instructions to the text formatter, and might include commands to set line spacing, format text, justify (left, right, full) a paragraph, and the like. Usually a certain word processor or formatter has its own set of procedural markup commands (Coombs et al, 1987).
Probably the most important and significant type of markup is descriptive markup. This specifies what text element a unit of data is, and allows you to describe and classify it. A descriptive markup (command) language approach allows the creator of a document to define a number of "element types" or "data structures," which identifies a text portion as a member of a certain class. For instance, you can specify if a piece of text is a long quotation, table, paragraph, or a footnote (Coombs et al., 1987;Tuck, 1989; Blake, 1989; MacLeod, 1990; Van Herwigen et al., 1990).

The power of markup languages is becoming more apparent for the efficient formatting and processing of text, especially with the increased interest in electronic text manipulation, desktop publishing, the Internet, and the World Wide Web. Descriptive markup is of particular importance, because it allows a description of a document or text element which is independent of its final form and output. One important component of any markup language standard should be the inclusion of markups for survey question types. These descriptive markup functions would be very useful in providing support for survey applications and for extending the usefulness of markup languages.

A practical example of an existing markup language standard is SGML (Standard Generalized Markup Language). This standard for marking up text has been defined by various publications (Association of American Publishers, 1992). A widely used subset of SGML is HTML (HyperText Markup Language), which is used to create hypertext-based documents on the Internet World Wide Web.

Using a descriptive markup language (Coombs et. al, 1987) approach to creating surveys appears to be a viable alternative to the manual direct manipulation or WYSIWYG (what you see is what you get) approach which is currently the basis of most text editing systems commonly used for creating surveys.
The descriptive markup (command) language approach allows the creator of a survey to select from a number of "element types" or "data structures," which classify a text stream as a member of a certain type. A document which has been tagged with descriptive markup can be processed by different kinds of systems, and is independent of its final form and the specific system it is being processed on. Instead of specifying the intricacies of formatting and text presentation, it allows the focus to be entirely on the questions and structure of the questionnaire as a whole. In addition, the markups are independent of the machine or system on which they are being used. (Coombs et al, 1987).

One of the most important benefits of a descriptive markup approach to survey design is its ability to minimize cognitive demands. Rather than recalling, selecting, and remembering codes for the creation of entry and coding of procedural markup, there is only one step involved in descriptive markup after recognizing the element type: to use the appropriate markup command together with the text to be "marked up." This frees the survey creator from formatting concerns inherent in traditional direct manipulation or WYSIWYG methods.

The use of descriptive markup also has the benefits of better maintainability and portability. In terms of maintainability, in the case where the actual formatting or structure of a question (element) type needs to be modified, this can be done by changing the processing program or system, without affecting the markups or text. This allows the same data to be used across different applications and platforms, resulting in greater portability. (Coombs et al, 1987; Tuck, 1989; Blake, 1989; MacLeod, 1990)

Going to a more general level, the benefits of markup could be related to the difference between command languages (markup) and direct manipulation (manual means). For a survey task, a markup language is best because users are familiar with the task, the number of element types is relatively small, dealing with survey questions as direct manipulation objects is slow and cumbersome, and the compactness of a command language makes it simpler to work with (Shneiderman, 1987).

A markup language allows a system to potentially aid the user by better expressing what the specific objectives or task is. The semantic approach inherent in the markup command language can be more effective than the direct manipulation approach, especially if incremental feedback, visual interpretation, or other learning aids are also used.

The command language or markup approach is inherently more efficient for a person who is an expert in the application domain. The degree to which the semantics of either match the specifics of the application domain provide more ability for the user to cognitively focus on their application, or in this case, the composition of a survey.

On the other hand, such approaches can be more difficult to learn by the novice who does not know the application domain. This is one reason why a markup approach also should have a powerful help system that includes material on learning the application (Shneiderman, 1987).

In terms of the design of the markup language, the full natural language name is used for many of the markup element types, since novice users are more confident in using the full commands (Landauer et al, 1983) and also many users show better performance on the system if they start with the full names, even if they prefer abbreviations later on (Grudin and Barnard, 1985).

The system supports the major question types common to most survey questionnaires: multiple choice, free response, Likert, semantic differential, explicit response, resource allocation, and rank ordering. The system is very flexible in administering surveys, by allowing it to be taken at the administrator's PC, at the subject's own PC, or in traditional hard copy form.

DESCRIPTION OF THE SURVEY GENERATION LANGUAGE

Overview

The language used in this program is adapted from the Standard General Markup Language (SGML) concept, however it has been modified with respect to syntax to make it easier to input and use. SGML is a complete language for specifying mark-up codes, how they are to be interpreted, and how the codes relate to each other (Tuck, 1989). The Markup Language Survey System (MLSS) is a software program designed exclusively for the creation of survey questionnaires. Its main goal is enable a user to create, edit, modify, and run online surveys using the markup language system.
The program has the following features:

a) INTEGRATED DEVELOPMENT ENVIRONMENT. This is a complete integrated development environment for creating survey questionnaires using a custom markup language specially designed to be easy to understand and use.
b) GRAPHICAL USER INTERFACE. The entire system, including both the Custom Editor and the survey run module, and features a graphical user interface (GUI).
c) CUSTOMIZED EDITOR/LEARNING FACILITY. This allows for the creation, editing, and saving of the markup language text. The ability to open up multiple editing windows, as well as a flexible, customizable help/learning facility system are featured.
d) PARSER (SURVEY GENERATOR) MODULE. This allows for the resulting online survey to be

presented in a graphical user interface format, and also can have the user "move a bar" to select a choice instead of typing, for some question types. Error checking and related features are included.
e) HELP SYSTEM. Customizable help/learning system.
f) DATA COLLECTION MODULE. Records responses from respondents into a data file. The data file can then be used for further processing, such as statistical analysis.
g) RUNTIME VERSION. A runtime version so that respondents can take the survey on their own PCs can be created.
h) MOUSE SUPPORT. The mouse can be used to do many functions in the program.
The extensions for survey/questionnaire data presented in the next section.

SURVEY GENERATION LANGUAGE SPECIFICATIONS

The following are the specifications, in detail, of the markup language created for this survey system. This gives the general form of each specific markup, an example of how it would be used, and an example of the output produced by using that markup. The question types which have been included represent the major types of questions which comprise survey questionnaires.

QUESTION TYPE: ALLOCATION OF RESOURCES

Description
This type of question is designed to allow the user to allocate resources between various choices. Examples of this include the allocation of funds, a certain limited resource, or some other material which can be measured in dollars or units. Basically, the respondent is given the choices, the amount of the resource, and some guidelines or restrictions on how it can be allocated. Then, he or she is asked to allocate the resource between various choices.
The following is the general form of the allocation markup:

GENERAL FORM

```
<allocation>
--allocation question text--
<limit>          <-- specifies allocation limit
<list /choice1/choice2/choice3/choice4/choice5....>
```

which will allow the user to type in the entries to allocate some resource.

<allocation> is the question type identifier. This should be at the beginning of the markup and be on a line by itself.

The question text should be placed after the above text, not in brackets.

The allowed allocation limit comes next. This should be in brackets, such as <2000>.

The <list.....> should follow the previous commands, which consists of an opening bracket, the keyword list, followed by a list of allocation choices, separated by forward slashes (/). The closing bracket completes the command.
This text :
EXAMPLE

```
<allocation>
ALLOCATION OF RESOURCES: You have a total
of $500.00
<500>
<list /clothes/vacation/computer/stereo>
```

will bring about the following output:

```
ALLOCATION OF RESOURCES: You have a total
of $500.00
Press the ESC key when done

clothes     ?
vacation    ?
computer    ?
stereo      ?

Total       ????
```

QUESTION TYPE:EXPLICIT RESPONSE

Description
Frequently, it is desirable to get responses which are of a certain type or format. For instance, you might want a binary choice (yes or no), or ask for the response to a true/false question, or ask someone's gender (male/female).
This kind of item asks for a specific response, such as 'Y' or 'N' or 'T' or 'F'.

GENERAL FORM

<explicit>
(question text)

The following are the components of the Explicit Response question:

<explicit> is the keyword for the explicit response question.

Question text is placed after the keyword in brackets.

EXAMPLE

<explicit>
Are you older than 21?

QUESTION TYPE: FREE RESPONSE

Description
Often, the need arises to allow the respondent to provide more information than just a single response (as in multiple choice or Likert/Semantic Differential) and instead allows the respondent to enter lines or paragraphs of text.
This allows for a response question similar to the following: What are your feelings about world peace?

GENERAL FORMAT
Each free response item or group of response items must have the following general markup:

<free response>
(text of the question)

When this markup is executed, it will display the question, together with an editing screen which allows the user to create a free-form text response to the question. The user enters the data into the editing screen much like he or she would when using a text or line editor. This text is saved as a response to the question.

EXAMPLE

<free response>

What are your feelings about world peace?

QUESTION TYPE: LIKERT SCALE

Description
Frequently, the need arises to express various levels of agreement or disagreement with a statement or idea. This is where the Likert scale is appropriate. For instance, someone could agree, disagree, be neutral, or strongly disagree or disagree with a statement.
The markup set up for this system allows for both the nominal (such as Strongly Agree...Strongly Disagree) and the interval scale type questions (with numbering 1..7 and the anchor points Strongly Agree...Strongly Disagree). This markup allows for complete flexibility in that the question designer can enter any kind of scale descriptors, as well as how many choices for the interval scale and specifying the anchor points.
The respondent is given choices on a scale, using English descriptors. A commonly used set of descriptors are the following: (Strongly Agree /Agree/Neutral/ Disagree / Strongly Disagree). The scales and questions are set up to suit the particular survey being created.

GENERAL FORMAT

<likert> --required function name
<[nominal/interval]> --type specifier
--text of the question-- --question text

<endpoints /endpoint1 /endpoint2>
<list /choice1/choice2/choice3/choice4----->

There are four basic elements to the Likert question markup:
<likert> is the required function name, which specifies what type of question it is.
nominal/interval. This specifies the type of question which will be produced. This includes both the nominal and interval types of questions. The nominal type will allow selected choices to be chosen, while interval will allow intermediate values to be selected. For instance, nominal will allow you to select SA, A, N, D, SD, while interval allows one to make a selection between SA and A.
<endpoints/ ./ ./ .> will specify the particular endpoints which will be placed on each end of the scale. Typical choices might be "Strongly Agree" on one end and "Strongly Disagree" on the other.
<list /. /. /.> allows you to specify the individual choices which you are allowed to make in

regards to the Likert question.
EXAMPLE

<likert>
<interval>
Winter is my favorite season.
SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree
<endpoints /strongly agree /strongly disagree>
<list /SA/A/N/D/SD>

which will produce output appearing as follows:

Winter is my favorite season.
SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree

: SA : A : N
: D : SD :

Strongly Agree

Strongly Disagree

QUESTION TYPE: MULTIPLE CHOICE

Description
One of the most commonly used types of survey questions asks the respondent to choose between various options. Whether it be age, income level, or any one of a myriad of topics, multiple choice is a necessary element of many surveys. The markup provided here allows for the creation of both alphabetic and numeric multiple choice. This is useful for cases where the response to a question can be one of several choices and for alternating between presentations.
GENERAL FORM
Specification:

<multiple choice> --required function name

--text of the question--
<(alpha/numeric) (single/multiple) (horizontal/vertical)>
<list /choice1/choice2/choice3......>

The following are the options for this markup:

<multiple choice> is the required keyword identifier for this question type.

text of the question, without brackets, follows the keyword identifier.

The third set of commands specifies the multiple choice options, which includes:

a) alpha has alphabetic choices, meaning that the user can select from one or more in a sequence of letter choices (a,b,c,d...).

b) numeric allows for choices using numbers, such as one or more in the sequence (1,2,3,4...).

c) single means that only one choice can be chosen from the list when answering the question.

d) multiple means that more than one can be chosen from the list, up to N choices when answering the question.

e) horizontal format means that the choices will be listed side by side on the screen or on paper.

f) vertical format means that the choices are listed on separate lines.

<list / / /...> specifies the choices for each of the selections in the list. The individual choices should be separated by forward slashes.
The syntax for the various choices need to be specified in the order presented above. Selection choices listed in the "list" markup should be placed exactly as they are to appear in the final version. The second line of any markup is the question text.

EXAMPLE/ALPHABETIC. An example of how this markup can be used is as follows:

<multiple choice>
What is your favorite color?
<alpha single vertical>
<list /blue/red/green>

which will produce output as follows:

What is your favorite color?

a. blue
b. red
c. green

Choice: []

EXAMPLE/OTHER FORMATS. Numeric will bring about the selections with numeric entries: 1. 2. 3. etc. The multiple option will allow selection of the desired (N) number of choices. Vertical presents the choices in a vertical list format, while horizontal does it in a horizontal side by side format. These are generally similar in appearance and do not need to be illustrated.

QUESTION TYPE: RANK ORDERING

Explanation

Another important type of question concerns rank ordering of items, in terms of preference, necessity, or some other criterion. The markup presented here allows respondents to rank order the choices given on the screen.

GENERAL FORM

The general form of the markup is as follows:

<rank order>
--text of the question--
<list /choice1/choice2/choice3/choice4---->

<rank order> is the required keyword for rank order question markups.

the text of the question follows the questions, and is not placed in brackets.

<list /./....> specifies the choices which you want to specify for the rank ordering. Each of the choices must be clearly separated from another using a forward slash (/).

EXAMPLE

<rank order>
Which present would you like best?
<list /car/computer/diamond ring/vacation>

where the type of question is presented in the top line, followed by the question, and after that, a list of the choices which the system will then present for rank ordering. After interpretation by the system, the survey respondent will be presented with output similar to the following:

====================================
====================

Which present would you like best?

car { }
computer { }
diamond ring { }
vacation { }

QUESTION TYPE: SEMANTIC DIFFERENTIAL SCALE

Explanation

Another widely used question type is the Semantic Differential, which typically involves descriptive endpoints and a numerical scale in which to select how strongly one feels about something. The semantic differential scale is supported in the system as follows:

GENERAL FORMAT

<semantic>
--question text--
<endpoints /endpoint1 /endpoint2>
<list /choice1/choice2/choice3/choice4/choice5...>

<semantic> is the required keyword for the semantic differential question text.

the question text follows the keyword <semantic> on a separate line, and is not placed in brackets.

<endpoints /./..> specifies the two endpoint descriptions which are displayed on the screen for that question.

<list /./././.....> specifies the individual choices which the respondent will select from when answering the survey.

EXAMPLE

<semantic>
Shoveling snow is lots of fun.
1=Agree, 4=Neutral, 7=Disagree
<endpoints /agree /disagree>
<list /1/2/3/4/5/6/7>

which will produce the following output:

Shoveling snow is lots of fun.
1=Agree 4=Neutral 7=Disagree

1 2 3 4 5
6 7
Agree
Disagree

CONCLUSION

The use of descriptive markup in tagging the content of data elements within documents is a viable means for describing the content of a file of text, without becoming involved in the complicated specifics of applications, platforms, and different kinds of text processing systems and software. Markup language standards such as SGML (Standard Generalized Markup Language) and HTML provide a means for explicitly defining text elements and documents using descriptive markup. This paper proposes a set of markups which are designed as an extension to markup standards such as SGML which are designed to provide an easy-to-use and flexible means for creating survey/questionnaire items. It allows the creation of survey questionnaires using a straightforward markup command language which minimizes cognitive demands, allows for more rapid development of surveys, and can easily be adapted for use on an electronic text-processing system. This could be used to add greatly needed survey questionnaire data types to existing markup language standards.

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THE RISE, FALL AND RESURRECTION OF EDI: A SMALL BUSINESS PERSPECTIVE

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ABSTRACT

This paper investigates, from a small business perspective, three data exchange techniques: 1) hard copy exchange, 2) computer-to-computer exchange and 3) electronic data interchange (EDI). An example of each technique, along with a discussion of the advantages and disadvantages, is provided. Additional emphasis is placed on EDI and its role in a small business. The small business can now outsource the EDI function to a third party consultant or organization which provides EDI expertise and services. The risks and benefits of contracting with these third party EDI vendors are addressed.

INTRODUCTION

Data exchange, in the world of business, is the transfer of data from one organization to another. As long as businesses have been in existence, there have been data exchanges. The corporate offices of State Farm Insurance Company in Bloomington, Illinois house a museum depicting the company's history. Among the items displayed are State Farm's first insurance policy and claims form. These documents are examples of data exchanges from the early 1900's.

The advent of computers changed the concept of data exchanges. Today, there are three popular methods used to exchange data:

1. Hard Copy Exchange
2. Computer-to-Computer Exchange
3. Electronic Data Interchange (EDI)

HARD COPY EXCHANGE

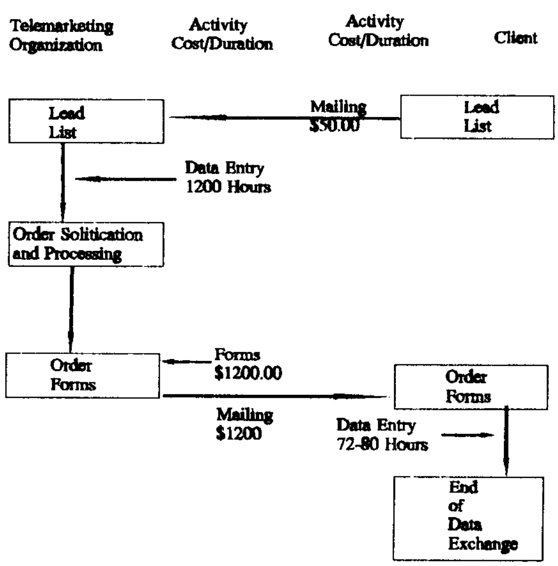
Originally, the information to be transferred was hand-written onto the exchanged document. Later, the typewriter was used. Both of these transmittal techniques have been replaced by computer-generated hard copy documents.

Work done by a mid-size telemarketing organization, recognized for its quality of service, illustrates one example of computer-generated hard copy exchange. In this application, the organization received a "leads list" of about 200,000 names. This information was printed on labels, with 30 labels per page. Thus, the manual data exchange consisted of over 6500 printed pages. At a price of .005 per label, this data exchange would cost over $1000 just for the labels. This amount does not include the labor, computer resources or overhead costs of the client organization.

Once the telemarketing organization received the "leads list", the data was keyed into their computer system. Each label required an average of 100 keystrokes for data entry. At a rate of 16,000 keystrokes per hour, the 200,000 labels took 1200 man-hours for data entry. From these 200,000 names, the telemarketing company could expect approximately 12,000 orders. The project took approximately 24 days, and generated an average of 500 orders daily. Each day, the telemarketing organization would print each order on a specialized form, costing approximately $.10 each. The document cost averaged $50.00 per day or $1200.00 for the project. Daily, after the 500 orders were printed, the documents would be sent via Federal Express. The postage for this express mailing averaged another $50.00 per day or $1200 for the project.

But, even more significant than the cost of the mailing was the 24 hour delay in the transfer of information from the telemarketing company to the client. The delay in the order processing did not end with the mailing. Once the client received the documents, they had to key the order information into their computer system. Estimating 100 key strokes per order, the labor delay would total 3-4 hours daily, for a project total of 72-80 hours. Figure 1 diagrams the steps in this hard copy exchange.

FIGURE 1
Hard Copy Exchange



The expense for this hard copy exchange is summarized in Table 1. This method of data exchange must be evaluated not only on the issue of cost, but also on the issues of speed, accuracy and security. The entire project was delayed in at least three ways: 1) 2 weeks for the data entry of the "leads list", 2) 24 hours for the mailing delay and 3) 72-80 hours for the data entry of order information. In addition to the data entry delay, one must consider the accuracy of manual data entry. An error in the phone number on the "leads list" would result in an incomplete phone call and the failure to obtain an order. Similarly, an error in the data entry of the order would result in an error in shipping, failure to receive payment and an unhappy customer. Yet, the hard copy data exchange is recommended from a security perspective.

TABLE 1
Costs of Hard Copy Exchange

	Telemarketing Firm	Client
Forms	$1200.00 (order form)	$1000 (labels)
Data Entry Labor	1200 hours	72 - 80 hours
Postage	$1200.00	$50.00 (labels-estimate)

Confidential information in the files of both the telemarketing organization's computer and the client's computer is not in jeopardy of exposure or modification as a result of the hard copy data exchange. Table 2 summarizes the advantages and disadvantages of the hard copy data exchange.

TABLE 2
Advantage & Disadvantage of Hard Copy Data Exchange

ADVANTAGES	DISADVANTAGES
Security of Computer Resources and Data No new software (labor or cost)	Forms Cost Labor Postage Speed Accuracy

COMPUTERS-TO-COMPUTER EXCHANGE

The disadvantages of the hard copy exchange quickly outweighed the advantages. With the growth of the popularity of modems, computer-to-computer data exchange grew in popularity. This method consists of one machine dialing another machine to gain access to one or more files. However, security concerns arose when the telemarketing organization looked into implementing the computer-to-computer exchange. They were not willing to surrender the security of their RS-6000 computer system, and the confidential data it contains, to any client.

To solve this problem, the organization elected to purchase a personal computer designated for communications use. Although the primary function of the computer was communications, it was used only a small percentage of the day for this function. During the remainder of the time, the computer could be used for other functions. At no time, was confidential data to be stored on this machine. The communications personal computer was equipped with a 9600 baud modem and ProComm software. ProComm software provided additional security because it can restrict users to a specific directory. Table 3 itemizes the setup cost for computer-to-computer data exchange.

TABLE 3
Computer-to-Computer Exchange
Set Up Costs

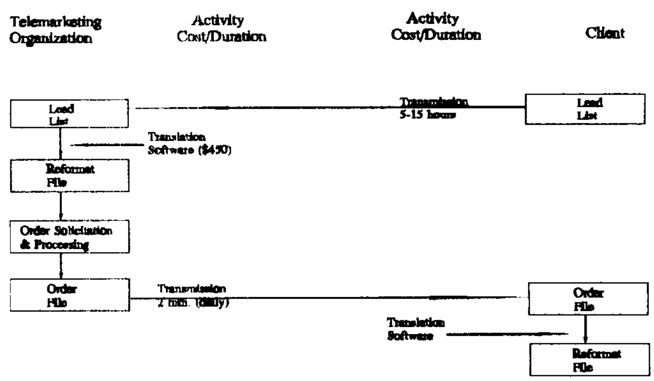
Item	Telemarketing Firm	Client
Personal Computer	$2000	$2000
Modem	250	250
Communications Software	150	150

The computer-to-computer link eliminated the need for mailings and the associated delay in the transfer of information. In addition, the time and labor required for the data entry were also eliminated. However, unless prior arrangements were made, the data transfer from the client to the telemarketing firm through the modem is usually in the format of the client's organization. This created a need for additional software to reformat the client files to the format required by the telemarketing department. This additional software required approximately 12-15 hours of programming. However, a few clients have varying field lengths which result in excessive hours in the programming of translation software. Similarly, the client may have to reformat the order file received from the telemarketing firm. Another 12-15 hours of programming time and cost must be included in the expense incurred in this computer-to-computer exchange.

Figure 2's diagram shows the computer-to-computer exchange just described. Notice that the data exchange occurs in both directions. Both organizations must have additional security, translation software, and communications hardware and software.

As a result of this computer-to-computer exchange, hard copy labor costs and forms costs, associated with the hard copy exchange, are eliminated. In addition, the mailing delay is removed. However, additional time is required in the coordination and scheduling of the data exchanges, and additional expense is incurred in the software to reformat the files. Since each client has their unique record format, this additional software is a recurring cost.

FIGURE 2
Computer-to-Computer Data Exchange



Another concern with the implementation of computer-to-computer exchange between the two organizations is the coordination required to schedule of the exchange. Complicating the exchange are variables such as 1) time zone changes, 2) legalities in each location or country and 3) local holidays or customs.

For computer-to-computer exchange to be successful, both machines must be available for transmission at the same time. It should be noted that 70% of the time, the first phone call does not reach the intended party (Stallings, 1990). International transmission, and sometimes local transmission, require knowledge of the rules and laws of the locality. In addition, various countries, and even local communities within the United States, have specialized holidays and religious customs which can compound the difficulty of coordinating computer-to-computer exchange. Table 4 summarized the advantages and disadvantages of computer-to-computer data exchange.

TABLE 4
Computer-to-Computer Exchange

Advantages	Disadvantages
Accuracy Reduced Costs Labor Postage	Set-Up/One-Time Costs Hardware Modem Communications Software Translation Software Coordination/Scheduling Time Security Concerns

Efforts have been made to standardize formats, which would result in the recurring software costs becoming a one time only or set-up cost. Electronic Data Interchange (EDI) was developed to provide the standardization of layouts.

EDI CONCEPTS

Electronic Data Interchange (EDI) is the standardization of layouts used in computer-to-computer transmission. From this standardization, common software can provide the creation of business documents. The most common business activities, for which EDI is used, are shown in table 5 (Hwang, et.al., 1993).

TABLE 5
Functions Performed by EDI Systems

Function	Percent of Usage
Purchase Orders	83.4%
Invoices	65.5
Purchase Order Change	48.4
Shipping Information	46.2
Materials Release	30.5
Order Status	26.6
Payment of Invoices	22.7
Product Availability	15.7
Price Quote	13.3

The EDI process requires each partner to standardize the layout of each file before transmission. The sending partner transmits the file to a "mailbox" provided by an EDI vendor. The receiving partner can call the mailbox at their convenience for the transmission of files from the mailbox to their own computer.

Three components are required for EDI to work efficiently: 1) mailbox services 2) transaction standardization, and 3) translation software.

Mailbox Services

The trading partners must determine the desired level of EDI services. Basic service is the transmission of standardized layouts, but many organizations look to a third party value-added network (VAN) provider. EDI service providers include: IBM, AT&T, MCI, and Sprint, but the largest provider of EDI services is GE Information Services in Rockville, Maryland. Other lesser known VAN's are Ordernet Services, a division of Sterling Software, and Target. The additional services of these providers include access control, security, file archiving and back-up files.

The VAN vendors monitor the access to the mailbox. The audit trail records the time, place and organization which places files in the mailbox, in addition to the time, place and organization which copies the information from the mailbox. Additional security is provided in the header record of each file. The header record identifies the sending and receiving organization. Only these organizations are allowed access to the files. The EDI service providers also transmits to the sending partner an acknowledgement of receipt of the file by the receiving partner.

Other services provided by the VAN includes archiving and backing-up files. For example, after a file has been transmitted to the receiving partner using GE Information Services in Maryland, the file is archived. If an error in transmission occurred, the file can easily be retrieved. GE Information Services have facilities in numerous sites within the United States. Duplicate copies of files are kept at each site. If a natural (or unnatural) disaster would occur and disable a site, the information services would continue from a different site with minimal interruption.

Transaction Standardization

The services provided by EDI vendors are beneficial, especially to smaller organizations. EDI on the conceptual level seems like a simple process. However, the creation of standardized transaction formats was a monumental undertaking. EDI dates back to 1975 when industry-specific standards were developed; however, cross-industry implementation resulted in competing EDI standards. In

1979, cross-industry standards, called X12, were developed by the American Standards Institute. These standards do differ in detail, but utilize the same general concepts (Drummond, 1993a).

The EDI standards define information and its layouts for applications relevant to a variety of industries. For each application, X12 defines major units of information called transaction sets. These transaction sets are divided into segments or records. Each segment is divided into data elements, which are variable length fields. Data elements are separated by an asterisk or another field separator. Segments and/or fields can be mandatory, conditional or optional. A mandatory segment or field must be included. A conditional segment or field is mandatory under certain conditions, such as the nature of the data or by previous agreement between the companies.

Problems have still been encountered because of differing *versions* of the EDI software. Communication and coordination are required between the two partners if the arrangement is to work smoothly.

Translation Software

Translation software must be developed by the sending organization in order to convert outgoing files into the standardized format. Similarly, the receiving organization requires translation software to modify the standardized EDI format so that it matches the records format used internally. Variable length fields and conditional fields increase the difficulty of the development of the translation software. In addition to reformatting the file, both organizations need to add detailed header and trailing records to the translation sets.

Translation software was required with direct computer-to-computer exchange between organizations. Rather than changing to/from the standardized layout, each organization needed to convert the layout of the partner to their own internal file layout. The software was unique for every organizational exchange. Thus, the translation software was a recurring cost. However, with the use of the standardized formats of EDI, the same translation software should be usable for most, if not all, exchanges in the same application area. Thus, the cost of translation software associated with EDI is a one-time (set-up) cost.

Advantages and Disadvantages

The overall cost of EDI can range from $1,000 to over $1 million. Variables affecting the cost include hardware configuration (mainframe vs. personal computer), the number of applications, and the size of the transaction sets. For example, EDI software for an RS-6000 costs approximately $1700 while similar software for the AS/400 can average around $20,000. In addition, EDI service providers can charge an initialization fee ranging from $200 to $1000. Typically, mailbox expenditures include a set-up charge of approximately $300 plus a monthly charge of approximately $100. Transmission charges average $.50 per minute in addition to the telephone charge. Finally, there is a storage charge of approximately one-half cent per 1000 characters of data stored in a mailbox. The average EDI client spends $40,000 on the project (Hwang, et.al., 1993). However, EDI does reduce, if not eliminate, the recurring costs of software translation.

An EDI partner must make provisions for updating the EDI software as new versions and releases are made available. In addition, on-going training for new personnel, and for all personnel on the new versions must be provided in the EDI budget. Program maintenance is frequently overlooked when creating an EDI budget.

EDI does allow an increase in productivity resulting from the use of standardized formats. Segment type and elements are common knowledge to the experienced EDI user. EDI also provides additional security in the form of audit trails, access control, file archiving and file back-up. Furthermore, EDI eliminates the frustration associated with scheduling transmissions in computer-to-computer exchanges. Time zone changes, local holidays and customs no longer impact the transmission.

However, EDI does require time for implementation. Most companies require 6 to 24 months to implement an EDI system (Hwang,et.al., 1993). In addition, there are some incompatibilities known as proprietary quirks, that occur between service providers. This becomes a problem if the sending organization has been using GE Information Services, and the receiving organization is familiar with the EDI services of AT&T. However, GE Information Services will reformat files into the AT&T format and will then forward the file from the GE mailbox to the AT&T mailbox for an additional charge. Table 6 compares EDI with hard-copy and computer to computer exchanges.

EDI Application

The telemarketing organization was forced to implement EDI because one client required EDI for all transmissions. Many organizations, such as WalMart, K-Mart, Target & even the U.S. Government, require that their suppliers use EDI. An

TABLE 6
Comparison of Data Exchange Techniques

	EDI	Computer to Computer	Hard Copy
Cost	high	low	high
Speed	fast	fast	slow
Accuracy	high	medium	low
Security	high	low/high	high
Implementation Time	high	medium	low

organization which drives the implementation of EDI with its suppliers, is known as a "hub" (Drummond,1993a).

Faced with the probability of losing a client, the telemarketing firm elected to investigate the implementation of EDI. The organization selected the same EDI service provider used by the client. The vendor provided two-hours of free training. However, the implementation was difficult. Although the same vendor was used, the vendor provided software, documentation, and training on a newer version of EDI than that being used by the client. In addition, the telemarketing organization received an incomplete copy of the manual and documentation of the EDI specifications.

The problems were eventually solved, and EDI was implemented. Figure 3 diagrams the EDI process at the telemarketing organization. Notice that EDI was used for the order processing. During the early stages of EDI implementation at the telemarketing organization, a new "in bound" application was developed to eliminate the leads list and associated data entry.

The telemarketing company completed its in-house order processing procedure to build the order file. The order file was then translated to the EDI format using a software package developed by the telemarketing firm at a cost of approximately $450. Once the file was converted, it was copied to a diskette for transfer to the communications PC. From the communications PC, the file was transmitted to the mailbox using a $1700 EDI software package.

The client retrieved the order file from the mailbox using a $20,000 EDI software package developed for the AS/400. This package also allowed for updating, inquiry and printing of several forms. The order file was then translated to the client's in-house format for further internal processing.

FIGURE 3
EDI Data Exchange

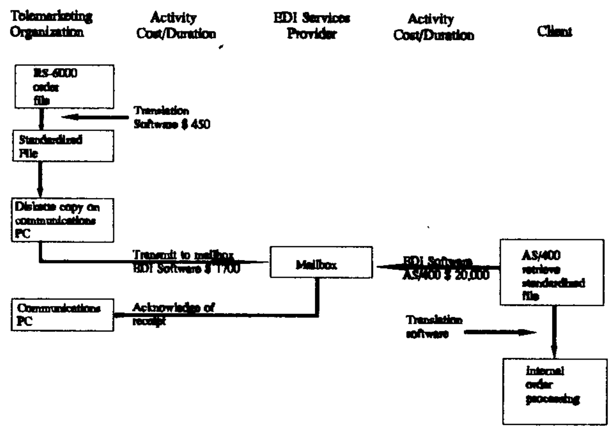


Table 7 documents the cost of EDI implementation and its use for the telemarketing organization.

TABLE 7
EDI Costs for the Telemarketing Firm

Activity	Cost
Training Expenditure	0[1]
Setup Costs	
Initialization	250
Mailbox	300
EDI Software for the RS-6000	1700
Monthly Charges	
Mailbox	175
Transmission ($.45/minute)	1
Data Storage (.005/kilobyte)	25
	[1]Out-of-Pocket Expenditures.

Although the problems of implementation were eventually solved, the frustration remained. Then, when the amount of transmission volume dropped by over 75%, the telemarketing firm renegotiated with its client because the costs of EDI outweighed the benefits. The telemarketing organization still reformats its internal file to be consistent with the EDI format. However, direct computer-to-computer and hard copy exchanges were used to replace the EDI service provider and the associated mailbox.

ANALYSIS OF THE EDI DECISION

Cost Benefit Analysis

Many small suppliers view themselves in the position of being forced to implement EDI in order to keep a large and valued customer. They see themselves caught between a rock and a hard place. They perceive two options: 1) do not implement EDI and lose a major customer or 2) implement EDI.

In order to make the decision, it is necessary to conduct a cost-benefit analysis. The first step is the identification of the costs. It is relatively easy to quantify the monetary costs of EDI. These costs include: 1) set-up charges, including EDI software, initialization fee, mailbox; and 2) monthly charges including mailbox, transaction transmission, and data storage.

The prices for the first four items can be obtained from various EDI vendors. However, the last two items are dependent on the size of the transaction sets. Relying on past history of the customer-supplier relationship and forecasting techniques (in addition to the EDI specifications), the suppliers can estimate the number and size of the transactions. From this information, the transmission and storage charges can be computed.

Other variables do impact the cost analyses. Are additional hardware and software resources, such as a modem and communication software, required for EDI implementation? In addition, personnel and training costs must be considered. These costs need to be divided into implementation (one-time) and the production cycle (on-going).

The implementation cycle will require the training of MIS personnel for the development of translation software and EDI procedures. In addition, EDI user training must be included in the costs. The implementation cycle can take from six months to two years. Thus, a percentage of the salary/benefits of MIS personnel must be calculated in the EDI costs. Once EDI is implemented, an EDI specialist may be needed for transmission and receipt of the transaction sets. In addition, the EDI process must be supervised and monitored for security and accuracy. Provisions for updating the EDI software and procedures must be budgeted. Analyses of the results, maintenance, and fine-tuning of the EDI procedures must be on-going.

The benefits are more difficult to estimate because benefits can be both tangible and intangible. Intangible benefits, which include better service to a customer and improved decision making, are difficult to quantify. Financial models can help compare the costs and benefits. Such models include 1) payback approach, 2) present value approach and 3) internal rate of return.

Third Party EDI

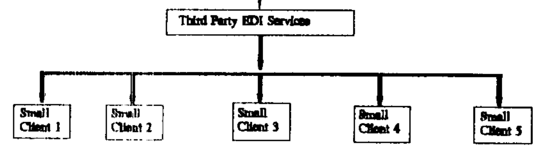
Many small firms fail to investigate a third option called third party EDI. Third party EDI vendors have a mailbox, software, and trained personnel. They will transmit the transaction sets for small suppliers. In essence, it is a second level EDI service provider. Figure 4 diagrams the hierarchy of EDI users.

The small organizations for which EDI is not financially feasible could contact a third party EDI service provider. This vendor can be an organization or an individual consultant. The third party EDI service provider would already be set up with EDI software and experienced personnel. The small user would choose to either 1) manually mail/deliver a diskette or hard copy of the appropriate information or 2) transmit the information via computer. The third party EDI service provider would be responsible for

1) translating, if necessary, the user file into the EDI format
2) transmitting the information
3) maintaining receipt of the file

In addition, the third party EDI service provider would copy all information in the mailbox for distribution to the appropriate small client. Delivery or pick-up procedures are pre-arranged between the small user and the third party EDI service provider.

FIGURE 4
Hierarchy of EDI Services



In a rural area of the United States, two small firms have been faced with the EDI decision and have selected the third party EDI service provider option. The first firm is a small manufacturing firm which was faced with implementing EDI or losing one of its major customers. They estimated approximately 100 transactions monthly. The second firm, an engineering firm, develops specialized instrumentation. One client contacts the engineering firm about twice a year for a specialized order, consisting of a single instrument. Thus, the number of EDI transactions for this organization would be minimal. It would be difficult for either of these two firms to justify the cost and time of EDI implementation and usage.

Third party EDI service providers have benefits from an economics of scale viewpoint. These service providers can charge their small clients a slightly higher transmission and storage change to cover a representative percentage of the overhead charges. Thus, the fixed costs of EDI can be spread over a broad base of small clients. However, these small organizations should be cautioned to investigate the reputation of the third party EDI vendor. This vendor will greatly impact the relationship between the small supplier and their valued customer (Williamson, 1991; Oltman, 1990).

A contract which delineates service level and pricing is a requirement. Multiple levels of transaction transmission and the associated price structure should be included. This will allow for an increase or decrease in the amount of communication between customer and supplier. In addition, the small supplier should investigate the experience and financial stability of the third party EDI vendor to ensure the probability that the vendor would remain in existence during the duration of the contract. Finally, the small client should request a short term clause in the contract. If the client is not satisfied with the vendor's service or with the contract, the partnership can be discontinued at the end of the short term clause. This would allow the client to renegotiate the contract with the same or different vendor.

CONCLUSIONS

Computer technology and associated applications, such as intercompany data exchange, is an evolving process. A basic process, such as computer-to-computer exchange, undergoes constant refinement to improve security and other internal procedures. Larger companies were faced with unique layouts and varying procedures with each computer-to-computer exchange. They sought the standardization of the exchange. EDI was the solution for these larger companies.

Unfortunately, EDI created problems for the small organizations. They found the cost of EDI to be prohibitive. Yet, they were being forced to implement EDI or lose a valued customer. This was indeed a major problem but, as might be expected, the computer industry is evolving and developing mechanisms to eliminate the problem. Individual consultants and organizations are contracting out EDI services, especially designed for small clients.

Advantages of these third party EDI service providers include economics of scale and knowledgeable and trained personnel in a specialized area. However, there are risks. The small client is transferring some of the responsibility for a satisfied customer to a third party. The reputation of this vendor is a critical factor in the relationship.

The role that these third party EDI vendors will play in the future is still in question. However, it is currently a viable alternative for the small client, who is caught between a rock and a hard place.

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PANEL SESSION

Computer Information Science An Emerging Discipline

A NATIONAL SCIENCE FOUNDATION PROJECT

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ABSTRACT

The National Science Foundation is funding a three year project to define the emerging discipline of Computer Information Science (CIS) that will fill a void between programs in Computer Science and Information Systems. Major tasks of the project include defining the body of knowledge, investigating new teaching/learning paradigms and developing cooperative links to industry. These cooperative projects will have teams of students and faculty working directly with industrial teams over multiple years in the development of large grain information systems. This panel will discuss the preliminary work on the project and solicit input from the participants and enter into a dialogue with interested attendees, to help shape the direction of the project. Future funding opportunities will be discussed.

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