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ABSTRACT

This issue of the higher education information technology magazine, CAUSE/EFFECT, presents in six articles six summaries of the best from this journal since 1978. The articles each summarize the writing done over the years in one of six key areas. The articles are as follows: (1) "Rise of Infrastructure" by Kenneth J. Klingenstein and Mark A. Olson (changes in computing and the resulting impact on applications architecture and technological and economic imperatives); (2) "Information Systems Development and Management" by Sandra T. Dennhardt (approaches to development, systems to support administrators, academics, management and decision-making); (3) "Organizational Structure for Managing Information Technology" by Robert R. Blackmun (centralization of decentralization and Chief Information Officers); (4) "Personnel and Operational Management Issues" by Albert L. LeDuc (including communication and cooperation, management roles, and entrepreneurship and marketing); (5) User Computing and Information Access" by Lore A. Balkan, Patricia S. Ernest, and Gerald W. McLaughlin (user support, library automation and access, administrative data access and security, and data standards and coordination); and (6) "Strategic Planning and Information Technology: Beyond Missions and Machines" by Sue A. Hodges and Ronald L. Moore (chronicles the linkages of planning concepts to technology). Included is a profile of the corporate sponsor and a list of CAUSE/EFFECT contributors of the year since 1981. Extensive references accompany most articles. (JB)

The Best of
CAUSE/EFFECT 1978–1991

On the Cover

The cover of *CAUSE/EFFECT* magazine has traditionally featured a photograph of the CAUSE member campus highlighted in the Campus Computing Environment section (in the early years called the College and University Systems Environment). On the cover of *The Best of CAUSE/EFFECT* are past cover photos, from the top center, clockwise: Arizona State University (Winter 1989), Dallas County Community College (Spring 1989), Hamilton College (Fall 1989), Boston University (November 1981), Vanderbilt University (Fall 1988), Michigan State University (November 1983), and (center) Virginia Polytechnic Institute and State University (March 1979).

The Best of CAUSE/EFFECT 1978–1991

Julia A. Rudy, Editor

CAUSE twenty years 1971-1991 OF MANAGING CHANGE

CAUSE is the Association for the
Management of Information Technology in Higher Education

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(see pages 48-49)

Complimentary copies of this paper have been provided to CAUSE member campuses, as well as to those attending the 1991 CAUSE National Conference. Additional copies are available to individuals at CAUSE member institutions/organizations at $8 per copy, to others at $16 per copy. Send pre-paid orders to:

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Foreword

"If you have a dollar and I have a dollar, and we meet and exchange dollars, we each leave with one dollar. If you have an idea and I have an idea, and we meet and exchange ideas, we each leave with two ideas." (Anonymous philosopher)

In the early development of CAUSE as a professional association, there was a maturation of mission from the exchange of "systems" to the exchange of "ideas." To amplify this exchange, the CAUSE Board of Directors saw a need for a professional publication as a medium for communicating ideas in the rapidly developing field of information technology in higher education. To meet this need, a prototype issue of *CAUSE/EFFECT* went to press in January 1978 announcing the publication and soliciting articles from members.

In Board debate prior to publication, the "magazine" format prevailed over a "professional journal" format for several reasons. The Board speculated that since the CAUSE members were more practitioners than researchers, a magazine would be more flexible and more readable than a journal. Also, the magazine format would not preclude the publication of scholarly works when appropriate. Another consideration was the desire to have *CAUSE/EFFECT* readership extend to college and university administrators throughout the client community rather than be limited to information systems professionals.

This special publication of *The Best of CAUSE/EFFECT* attests to the vision of the CAUSE Board of Directors in establishing an association magazine as a medium of exchange for ideas. CAUSE members, and other readers of the magazine, will thank the authors of the several chapters of this publication for advancing the exchange of ideas to another level by their summarization of the selected *CAUSE/EFFECT* articles into six major areas. It will undoubtedly take its place alongside *CAUSE/EFFECT* on the active reference shelves of many key administrative offices in colleges and universities.

Charles R. Thomas
CAUSE Executive Director 1971–1986
CAUSE/EFFECT Editor 1978–1982

Preface

Since this short publication already has a foreword and an introduction, a preface may seem superfluous. Nonetheless, I couldn't resist the opportunity as we celebrate CAUSE's twentieth anniversary with *The Best of CAUSE/EFFECT* to recognize the foresight, commitment, and professional effort of four groups of individuals: the CAUSE Board, *CAUSE/EFFECT* authors, members of the CAUSE Editorial Committee, and the magazine's editors. Collectively, these individuals are responsible for the excellence that has increasingly characterized *CAUSE/EFFECT* magazine since its inception.

Early in the history of CAUSE, the Board of Directors recognized the importance of creating a body of literature, authorizing the initiation of publication of *CAUSE/EFFECT* in 1978 and continuing to strongly support it ever since. Creating an Editorial Committee of the membership to review and select feature articles, assigning a Board member as liaison to the Editorial Committee, establishing an annual award for the author of the best contributed article, and continually discussing and suggesting how to strengthen the magazine are ways in which the CAUSE Board has demonstrated its support and belief in the value of *CAUSE/EFFECT*.

In the 75 issues published between January 1978 and Summer 1991, 446 articles by 400 different authors have been published. These authors have freely shared their professional insights and perspectives through *CAUSE/EFFECT*, advancing the state of management of information technology on campus and personally gaining professionally.

Review and selection of articles for publication is a time-consuming and often thankless task, pursued willingly by dozens of volunteers serving on the Editorial Committee. Their work has provided essential quality control, ensuring that every issue of *CAUSE/EFFECT* is the best possible.

Ultimate responsibility for the excellence of *CAUSE/EFFECT* has rested with its two editors, first Charles R. Thomas from the inception of the magazine in 1978, and then Julia A. Rudy beginning with the May 1982 issue and continuing today. Both editors have consistently balanced and supported the perspectives of the Board, the Editorial Committee, and the individual authors to produce cohesive issues meeting the highest standards of quality.

So much of what has been published in *CAUSE/EFFECT* is excellent that it has been difficult to identify what is "best." It is my hope that this task will become even more difficult in the future as more and more join the ranks of authors who seek to share with others the benefits of their knowledge through publication in *CAUSE/EFFECT*, contributing to the growth of our profession and their own professional growth.

Jane Norman Ryland
CAUSE President

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CAUSE extends its deep appreciation to the members of the
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whose dedicated efforts made this publication a reality:

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"This book is dedicated to the 400 authors who have contributed articles to CAUSE/EFFECT since its beginning, and to the hundreds more who in coming years will continue the tradition of sharing expertise and experiences for the benefit of their colleagues and the profession."

Introduction

by Julia A. Rudy, CAUSE/EFFECT Editor

Two years ago, the CAUSE Board of Directors approved the appointment of a dozen CAUSE members to an ad hoc committee to develop a publication to recognize outstanding articles published in *CAUSE/EFFECT* magazine since its inception.

Initially, our intention was to publish a small number of articles in their entirety in a special "classic" issue of the magazine. But after reviewing more than a dozen volumes of the magazine, the committee agreed that a different approach was called for. Quite simply, we had found many, many articles that were insightful or forwardlooking for their times, dealt with issues or provided information still relevant or of value today, or addressed emerging management concepts or technological issues that have had a significant impact on the growth of the profession.

Thus, *The Best of CAUSE/EFFECT* looks not at just a few "classics," but at dozens of articles published by many different authors through the years. In reviewing the 75 issues of the magazine published from January 1978 through Summer 1991, we identified six major areas that authors have written about: (1) building the technological infrastructure, (2) information systems and applications development; (3) organizational structures for managing information technology; (4) personnel and operational management issues; (5) user computing and information access; and (6) strategic planning and management.

Selected committee members (some in conjunction with other colleagues) undertook to write about these areas through examining articles that had been selected and placed by the full committee into one or more of these areas. Although the committee labored long and hard in reviewing articles for inclusion in these overviews, we are, alas, fallible and may have overlooked articles that might have been included. Likewise, not every trend or significant occurrence of the recent past is found in these pages. What is presented here, however, is reflective of prominent concerns of the 80s as seen through the eyes of the campus information technology professionals who published articles in *CAUSE/EFFECT* throughout the decade.

A word of caution to the reader. As you will very quickly discover, this publication was not intended to be read in one sitting! It condenses and arranges a great deal of information into more-than-bitesize chunks, and should be approached as you would approach a text or other reference book. Rather than offering a single bibliography of unduplicated references for the entire work, we have provided a bibliography for each chapter at its end. These six bibliographies should provide a good starting point for pursuing further research into these specific areas.

Though at least in part a celebrative publication—the committee worked diligently to ensure its completion in time for CAUSE's 20th anniversary celebration at CAUSE91—*The Best of CAUSE/EFFECT* is also a publication to remind us not only of the development of technology in the last decade, but also of the development of those who have the daunting task of managing that technology and advocating its effective use. This book is dedicated to the 400 authors who have contributed articles to *CAUSE/EFFECT* since its beginning, and to the hundreds more who in coming years will continue the tradition of sharing expertise and experiences for the benefit of their colleagues and the profession.

From its early focus on administrative information systems, the association's mission evolved and broadened throughout the decade to its present mission of promoting the effective planning, managing, and evaluating of all information technologies in higher education—including academic, administrative, and library computing as well as voice, data, and video communications. Thus, in recent years, articles in the magazine have begun to reflect the broader issues that face our campuses.

As we look ahead to the next decade, it may be helpful to summarize some lessons learned in the 80s, evident in the articles overviewed in this retrospective publication:

- that managing information technology extends beyond the walls of the central computer center
- that information systems and technology must support *all* functions of the institution—instruction, research, public service, and administration
- that information and the technologies that support its creation and dissemination are institution-wide resources that must be managed and planned for
- that computing professionals must be sensitive to and work toward understanding the needs of all computer users on campus—from students, to faculty, to staff, to administrators—which means developing a quality and service orientation.

In September 1981, the winner of the first *CAUSE/EFFECT* Contributor of the Year Award, Robert J. Robinson, closed his award-winning article with a look toward the 80s:

> The decade will be one of excitement and challenge in higher education, a decade in which many hopes of past years for coherent use of information technology will be fulfilled. Today, more than ever, higher education requires the best thoughts, ideas, criticisms, and cooperation of its leaders as the new information technology is assimilated.

With the spirit of cooperation, new brand of leadership, and strong transformational vision that have emerged from the 80s, perhaps *this* will be the decade in which those hopes are finally fulfilled.

"The appropriate information technology environment for the future of higher education will be centered on an institution-wide information network, based upon broad access to personal workstations, enhanced by a diverse set of server facilities, and integrated through a coherent software environment."
Van Houweling, July 1985

1
Rise of the Infrastructure

by Kenneth J. Klingenstein and Mark A. Olson

It begins in the lab. Perhaps in a corner of a well-manicured facility, as someone fabricates the first transistor to imitate a vacuum tube, or passes pulses of light through an optical fiber. This origin may be a small office in academe, as a professor contemplates the performance possible if one works only with simple instruction sets, or in a garage, as a user group tries to figure out what can be built around microprocessors. Something is born, an idea or a technology, and the ripples build out.

How far and fast those ripples spread depends on much besides the technology. Economic forces, legislative and regulatory factors, the degree of standardization, and the existence of other complimentary technologies all bear great influence on the future. Beyond these, user needs and the workings of the marketplace play out just how a technology transforms the world.

For computing and communications, the changes in technology and the world it creates have been staggering over the last twenty years. Coupled to the changes in the structure and operation of colleges and universities, the result has been a continuing set of challenges for higher education in the management and use of computing and information technology.

While the one constant in the environment is change, the vortex of change has shifted during the period. Each successful advance has enabled a set of new challenges, new possibilities. In the age of the IBM 360, little was available, so little was possible. No one talked of the GUI in OS/360; no one suggested end-user computing when there were no end-user devices. There was no discussion of network-based information when there were no networks. Subsequent progress, building on itself, has opened doors, creating issues.

In the last year, two definitive articles in *CAUSE/EFFECT* captured these shifts over time. The first, by Freeman and York (Spring 1991), traced the changes in computing and the resulting impact on applications architecture. Exhibit 1 from that article (see page 4) shows the transitions in computing environments from the 1960s to the turn of the century. Almost every component, from the computing platform through the databases to the applications that run on these systems, has undergone fundamental transformations and will continue to evolve rapidly. As the authors point out, the agent of change has been the technology:

> The client/server concept emerged, not as a full-blown architecture waiting for technology to make it feasible, but rather out of the need to bring order to, and capitalize on the capabilities provided by, this new computing environment.

The second article addressed where we have been and tracked where we need to go. In this visionary piece, Peters (Summer 1991) described the technological and economic imperatives that are bringing information into the information age:

> The use of networked information resources and services promises to reduce the costs of acquiring library materials, to stabilize the rate of growth of the space required to house library materials, and to increase the rate of use of library materials. It is not yet clear that these specific promises will in fact be realized, but a great deal of contemporary effort is motivated by the hope that they will.

This chapter focuses on how the once and future transitions in hardware, software, and analytic approaches have been reflected in the pages of *CAUSE/EFFECT* magazine. There have been essays of remarkable insight, predicting trends and issues far ahead of their time. There have been reports on new architectures that have led us all forward. And, to be sure, there have been some writings that have not aged so well, works caught in a tempest that soon blew over. A look, then, at how *CAUSE/EFFECT* has marked our technological passage.

Exhibit 1
Computing Environment Evolution

	GENERATION				
	1	2	3	4	5
YEAR	1960	1970	1980	1990	2000
Model	Batch	Online	Online transaction processing	Client/server	Universal connectivity
Interface	Cards and printouts	Typewriter terminal	Full-screen character terminal	Graphical user interface	Multi-media, speech
Data Management Platform	Sequential	Indexed	DBMS	RDBMS	Complex objects
System Platform	CPU	CPU + line-at-a-time terminal	CPU + full-screen terminal	CPUs + local area network + intelligent workstation	CPUs + local area network + intelligent workstation
Application Development Method	Structured	Process	Screen	Data	Object
Benefit	Automation	Timeliness	Mission-critical	Strategic	Survival

This matrix divides computing environments into five generations that conveniently coincide with the start of a new decade. (The precision of this alignment should not be taken literally, but the date indicates when that generation has entered the mainstream.) It appears that many users are confused by the terminology adopted by vendors, as well as by how evolving technologies relate to their own knowledge and experience. This matrix presents a schema for the description of computing environments, which outlines some basic shifts occurring in the technology of data processing. The key idea behind the diagram is that certain style changes in the environment can be grouped at a series of time boundaries, and that the characteristics of each generation seriously affect the skills and resources required to enjoy success at that level. Thinking about computing environments within this framework should help in understanding the value and relevance of installed technologies and methods, evaluating the positioning and capabilities of vendors, and making decisions about the deployment of resources to support strategic information goals.

From Freeman and York, Spring 1991

The Early Years

CAUSE/EFFECT was launched in 1978. By that time, university computing was three decades old, and was beginning a rapid transition in hardware and software. After two decades of development in mainframe computing, minicomputers had entered the arena. Minis caused two fundamental shifts in the traditional computing paradigm. By offering cheaper and abundant cycles, they gave life to the concept of interactive computing and a host of new applications (from word processing to real-time systems). The second impact was to negate the idea of the monolithic computer, and suggest that computing environments would become distributed and heterogeneous. To achieve that environment would require additional invention, but there were folks at work in the labs.

Still, those early issues of *CAUSE/EFFECT* dealt with the environment at hand. Articles examined application programming in the traditional sense, how to justify mainframe

upgrades, and the operation of state-wide university computing centers. The challenge of the day was to improve the functionality of payroll/personnel systems.

But, in a visionary article in November 1981, Chachra analyzed the activities in the labs, and made a number of predictions that proved quite accurate. By considering the progress in CPU performance and memory cost, Chachra projected that "the cost of computing will be governed not by hardware costs, but rather by personnel, software, and communication costs." (That much of his reason for this prediction was based upon a belief in the Josephson junction should remind us that even the best of seers are sometimes right for the wrong reasons.) He also foretold the movement from tape to disk, and that "as more and more operating system functions get built into the hardware or microcode, the luxury of making local mods may cease to exist."

By 1982, the pages of the magazine began to carry reports by the avatar institutions on new hardware and new applications, and the resultant changes in the analytic and organizational perspectives of the institutions. For example, in March of 1982, Wineland talked not only of the advent of word processing, but of electronic mail as well:

> Carnegie-Mellon is becoming deeply involved in ... the use of a computer to enhance human-to-human communication in several modes: dedicated word processing system, word processing package on a general-purpose minicomputer, computer mail, text editor, text formatter, spelling checker, and programmable printer.

This same article provided another harbinger of the future when Wineland innocently noted that "the computer science department has ten Xerox Altos." The personal computer was at our doorstep.

Advent of the PC and Rise of Networks

The landscape shifted forever in 1982 with the introduction of the IBM PC. While there were already micros sprinkled in academic sites, they lacked the imprimatur status that the IBM logo brought.

Articles describing the application of PCs to campus computing began to appear regularly in *CAUSE/EFFECT*, culminating in a special July 1983 issue that was devoted to the new technology. There were articles for the uninitiated, defining terms and uses (Harris), essays from schools knee-deep into deployment (Bomzer), and an alert about some of the difficulties that PCs could cause in administrative computing. While this latter management issue was leading some institutions to tightly control the acquisition of PCs, Doty opened our eyes to the real solution:

> Most efforts to curb the flood of small computers have been through hardware approval policies, but the real issue is the control of information. Ease of use is easily turned into ease-of-abuse. Data processing managers who want to avoid the dangers of uncontrolled decentralization will need top management recognition of data as a corporate asset and support for procedures to control the management of data on all devices.

While the tide of PCs rushed in, a debate arose about their value beyond the obvious stand-alone applications such as word processing and simple spreadsheets. As users attempted more sophisticated use, such as database applications or decision support tools, significant obstacles arose, based largely on the need to move both data and their meaning between computing environments. Essays in *CAUSE/EFFECT* discussed the conflict between centralized and distributed systems; the issue was sometimes misconceived as an either/or choice. Yet, for some authors, the issue was clear: the challenge was how to effectively couple both distributed and central computing. And, as before, in the labs there was work on the key piece to answering the challenge—computer networks.

"It is tempting to delay the implementation of these changes because the technology will become faster, or cheaper, or to wait for others to make the mistakes. Many institutions will wait too long ..."

Again, as with distributed versus centralized computing, there was a tendency to cast the issues as diametric choices. Was the campus communications environment to be multiple separate networks or a single multimedia service? In a September 1983 Current Issues article, Kelley placed the issue into context:

> An integrated communications utility does not preclude separate cable and switch systems for voice, data, and video. However, a fragmented management approach to communications resources precludes the flexibility of using the most cost effective solution, whether it be integrated or not.

Kelley also identified that "... the integrated management organization must precede the integrated technical implementation."

The campus network environment exploded with the rapidity of the PC wave, and within a year of the special issue on microcomputers, a special *CAUSE/EFFECT* issue on campus networks was published. In his kick-off article in that issue (September 1984), West referred to "the contagion period for telecommunications in higher education." The gamut of articles in that focus issue reflected the spread of the matter.

Arns and Urban provided a comprehensive discussion of the overarching issues, and in doing so laid a blueprint for many schools to follow. Covering the territory from media issues to information integrity, they urged that institutions embrace networks.

> It is tempting to delay the implementation of these changes because the technology will become faster, or cheaper, or to wait for others to make the mistakes. Many

institutions will wait too long; the technology will always be improving and getting cheaper. The rate ... of ... adopting the microcomputer makes it imperative that we bring information technologies promptly to center stage. The integration of the micro implies the establishment of a data communications network and the attendant adjustments in the way we conduct our activities.

Klingenstein talked of the value of a campus-wide network to provide access to multiple platforms and applications. While the network can provide the glue, it begets the need for consistent interfaces and applications. The lack of these was an example of Murphy's Law, "which is quite prevalent in a discipline where micron precision is critical but the discrepancy in so-called standards is rampant." Bleed demonstrated the theory in practice in a description of the installation of the network at the Maricopa Colleges, the success of which was due to "the chief executive officer's total commitment to using the ... system."

> *"Certainly it will take us a generation or more to fully comprehend the possible impact on our lives of the integration of computing and communications."*

Also worth noting in that *CAUSE/EFFECT* focus issue on telecommunications/networking was McCredie's article about the developments of external networks, in which he sketched the rise of the major computer networks (Arpanet, BITNET, and so forth) and signalled the path to be taken:

Since there are no political forces in the United States to limit the number of different academic networks, ... they will continue to grow in size and proliferate in variety. This growth will be compounded by the constantly decreasing cost of computer hardware. This proliferation has obvious associated costs and disadvantages. However, the newness of this field and the dynamic growth of new ideas are such that it is premature to try to restrict the growth with artificial means. Gateways among networks offer the only reasonable technical and organizational approach to the problems inherent in this proliferation.

The Marriage of PCs and Networking

Chachra foretold the impact of microcomputers and the networks that would connect and augment them in a July 1982 Current Issues article. Referencing the theory of W. J. McKeefery that there are only a handful of technologies—three to be exact—that multiply man's ability to perform a task by a factor of a million or more, Chachra noted,

The combination of computers and communications begins to achieve a million multiplication of a million multiplier. Certainly it will take us a generation or more to fully comprehend the possible impact on our lives of the integration of computing and communications.

His response to the question—"How do we prepare ourselves to take advantage of this powerful combination?"—was: "We must move towards an environment that has multipurpose workstations connected to multifunction networks."

As the number of PCs and networks grew, so too did the reflections in *CAUSE/EFFECT*. Two articles, one practical and one visionary, led the way towards the integration of the technologies. "Servicing Personal Computers," an award-winning article by Heterick and Khanna (January 1985) identified the critical services that PC users would need from the network: "Workstations can be supported by 'service machines' which offer specialized services such as print and graphics, file storage, mail, etc. as value-added features." Their article provided a detailed analysis of these needs and suggested, quite wisely:

... several years will be required for vendors to develop products that address the campus computer network marketplace. While such products are under development, it is possible for the campus network to utilize existing resources (i.e., mainframes) to begin. ... The nucleus of the concept is the file service machine and a client interface protocol.

The second notable article, a Viewpoint by Van Houweling (July 1985), reinforced the role of the network in the computing and information setting of the university:

The appropriate information technology environment for the future of higher education will be centered on an institution-wide information network, based upon broad access to personal workstations, enhanced by a diverse set of server facilities, and integrated through a coherent software environment. ... In other words, the information network will occupy the institutional niche formerly occupied by the central computer.

As is the case with any new technology, the rise of networks created a host of management and planning concerns, addressed by Creutz's thoughtful evaluation of such issues as coordination, cost control, functionality, flexibility, and relationship between telecommunications and management information systems. His article (May 1986) included an action plan to assist an institution in "rationalizing" its telecommunications services.

Of course, not all institutions had the opportunity to carefully plan their campus networks. For the many campuses who needed to jump in quickly, True and Rosenwald provided a blueprint for a refreshing alternative. In the July 1986 *CAUSE/EFFECT*, they outlined a semi-planned prototyping scheme.

To make the project happen quickly, we established some informal ground rules. We would not study the project to death. We would select one vendor, install the system, form a users group, and see what happened. The users would evaluate and select the software. Comput-

ing Services would offer some training on the use of the LAN and the user group would hopefully offer peer training based on the "emerging expert syndrome."

Indeed, while their experience was with LAN development, their conclusion was more widely applicable: "The key to end-user satisfaction in this, as in all projects, is end-user involvement."

Harnessing the Power

It's safe to say that the interest of *CAUSE/EFFECT* readers and authors in computers and networks lies less in the technologies themselves than in the management systems and useful applications that can be built upon them. The steady progress in hardware over the last twenty years has forced a fundamental change in how we analyze our management needs and design systems to meet them.

The transitions in software and system design are less dramatic than in hardware. As Freeman and York put it:

> At the moment, the industry is still "out ahead of its blockers"; the hardware is available to assemble complex webs of powerful workstations and servers, but it is not yet matched by the standards and the software technology for using and managing these resources productively.

Still, there have been major changes in the applications environment, and the pages of *CAUSE/EFFECT* bore witness.

The history of *CAUSE/EFFECT* has revealed dramatically the evolution of the systems environments and methodologies with which we have developed and delivered our applications systems. Early insights anticipated the evolution of new software design and development tools, and recent articles argue the arrival of these techniques. From traditional methods of systems development life cycle design to iterative prototyping and fourth-generation language code-generation tools and software engineering technology, we have witnessed and participated in a fundamental change in both the method and the systems available to manage our applications development processes. A review of these changes as they appeared in *CAUSE/EFFECT* provides more than anecdotal diversion, rather, anticipation of developments yet to come.

In an early cry for a revision to our systems design methodology, well before our systems provided us with the tools to fully take advantage of the theory, Rice (May 1979) suggested heuristic design techniques:

> Software design needs to be more like a science or technology. However, there is no generally accepted method for developing the body of knowledge necessary to make the transition. While none of these problems are new, a solution continues to evade us.

He argued for a heuristic approach to recording design and programming problem solutions, to relating new application challenges to previously solved (recorded) problems, and to replacing original solutions when new ones are determined. What evaded the profession in 1979 were the systems tools and environments that we can begin to access today. Rice's

"... an environment should be created in which users can do more and more of their own computer-related work."

article constituted an early call for computer-assisted software engineering (CASE) and principles inherent in a design methodology that takes careful advantage of already solved problems and design techniques. His heuristic approach revealed an early understanding of the dynamic and recursive nature of iterative systems design and programming development.

Two years later, Chachra (November 1981) presented what was essentially a very technical and hardware-oriented analysis, but he could not ignore the real impact of the tools we use and personnel costs:

> Since software costs are linked very closely to personnel costs, it is expected that its rate of increase will follow the trends for personnel costs, at least until more advanced software development tools become available.

Anticipating later issues of distributed computing, he added:

> ... an environment should be created in which users can do more and more of their own computer-related work. This would apply both to the operation of information systems and to the development of software.

Surely today's discussions of Upper CASE, Lower CASE, I-CASE, and the sales of products such as Knowledgeware, Programmer Workbench, AD/Cycle, and the list goes on, were anticipated by Chachra a decade ago, and the impact on personnel costs are being realized.

In an article about Clemson University's systems development approach (March 1982), Alexander detailed the components of their design and development methodology: (1) online report request software; (2) online table maintenance systems; (3) integrated data dictionary; (4) common techniques in online systems development. Remarkably, Clemson computer professionals developed their own tools, though Alexander anticipated what we see today:

> There are many productivity aids being marketed which promise to reduce drastically the drudgery of systems development. These aids are usually linked closely with a particular database management system and teleprocessing monitor. The next generation of productivity aids used at Clemson will most likely be totally vendor-supplied software, rather than locally written extensions to vendor software.

Echoing both Alexander and Chachra, Sholtys (November 1983) wrote about the potential for systems prototyping with 4GL tools:

> A basic challenge facing campus computing centers is one of supply and demand: the demand for information systems far outstrips the supply of personnel available to develop the systems. Significant programming backlogs

> are a way of life at most centers. New software tools with the potential to improve systems development productivity are available but utilization is not widespread.

One might suggest that today we still do not see "widespread" use of readily available tools and what are really best called "systems environments" for development and delivery of application systems.

Another call for use of prototyping techniques, by Lowry and Little (July 1985), sensed the need to tie these new methods to traditional development methodologies, while urging transformation of the basic methodological foundations. These authors had found success at the University of Miami through prototyping but learned an important lesson:

> In our first attempt to incorporate prototyping into (traditional) systems development, the prototype was introduced at the end of the design phase, and was constructed to validate the systems specifications. This approach actually added steps to the development process and may have cost as much as 10 percent in total development time. The traditional methodology had guided the project team through a structured implementation pattern, whereas the prototyping approach could have eliminated several steps. In hindsight, much of the time spent in the classical process was wasted.

"The technology to implement effective client/server systems is now emerging, but key standards, tools, and skills necessary to construct them are only nominally available."

Just as our development tools and systems environments advance, so must our basic life cycle development methodologies evolve.

As database technology became increasingly more sophisticated, the significance of the interface between user and computer grew. Nicholes (January 1988) recognized the limitations in this area in spite of rapid technological advances:

> In the last several years, we have seen science fiction become near reality, yet in the area of man-machine interaction, we are still extremely limited. Although television depicted *Star Trek*'s Mrs. Spock or Captain Kirk speaking to the ship's on-board computer, and getting the response back in friendly and conversational tones, for all of the romance of such scenes, the true state of the art is just now beginning to approach that capability. A more realistic approach is found in the increasing use of database query languages.

His article reviewed database technology and the pros and cons of end-user use of database query languages, specifically addressing the issues of training, accuracy of reports, conflicting employee tasks, and levels of complexity. He concluded that "tools such as data query languages can greatly enhance the ability of workers today to get their jobs done. And for now, that's what it is all about."

Certainly Heterick anticipated the need to link our strategic vision of information systems architecture and methodologies with our business needs and goals. In his classic "single systems image" article (September 1986) he wrote,

> Our major problems will occur in the transition from where we are today to where the strategy suggests we should be in five years. We should treat such problems as tactical questions, resolved in the context of the strategy we follow, but addressed in terms of the technology available when the tactical problem is identified. Fundamental to this transition is the establishment of an information systems infrastructure.

The key is that we must ensure that our development methodologies and techniques take place within a context of a strategic vision, grounded in an advancing technology, enabling significant advantages and enterprise-wide transformations in our information systems development.[1]

The New Paradigm: Networked Information Resources

As we enter the 90s, *CAUSE/EFFECT* continues to provide articles that point to where we are headed. Several recent articles directly addressed issues we will likely face in this decade. Freeman and York's comprehensive work on technological architectures predicted:

> Client/server computing is as important to the 1990s as the time-sharing model was to the 1980s. It will initially cause confusion but will ultimately lead to systems that are highly functional, easy to use, and affordable. The technology to implement effective client/server systems is now emerging, but key standards, tools, and skills necessary to construct them are only nominally available. Hence the transition to this new environment will not take place overnight; rather it will emerge gradually in the coming decade.

A major development of the 1990s will likely be campus-wide information systems (CWIS). These wide-access systems contain "popular" information ranging from compendia (such as intramural schedules or dining hall menus) through academic information (academic calendars, course catalogues, and so forth), to personal services (such as job postings and question-and-answer exchanges on institutional or social topics). CWIS offer colleges and universities the opportunities to post volatile information in a timely manner and can help students cope with the maze of institutional bureaucracy by providing information on demand. While the CWIS technology is fairly standard, the management of the system and the data are not well-

[1] See Dennhardt's Chapter 2 discussion of other *CAUSE/EFFECT* articles that have dealt with the need to build an information architecture and systems that fit institutional strategies, pp. 13-15.

understood. Using and reconciling multiple information streams, the potential and the liabilities of electronic support services, and the social consequences of CWIS, will undoubtedly be explored in the pages of *CAUSE/EFFECT* in the years to come.

Continuing its approach of devoting special issues to topics of temporal importance, the Summer 1990 *CAUSE/EFFECT* focused on libraries and information technology. Heterick's article on networked information resources in that issue laid out the threat to academic research libraries:

> What are probably already the largest buildings on campus can be expected to double in size every 10 to 15 years. If for no other reason than to blunt this exponential increase in physical size, libraries will need to find a way to serve their patrons without being repositories for some significant segment of the world's information stock in the form of physical artifacts.

Heterick cited many obstacles, from converting current physical libraries to electronic form to library accreditation metrics to the problems of the current copyright law. His call to arms will serve as our agenda for the next few years:

> A paradigm shift for libraries is under way. Its full development awaits the resolution of a number of thorny societal problems. Libraries must look to state and federal governments for help in resolving copyright and "fee for service vs. public good" issues, and networks must become populated not only with bibliographic offerings of libraries, but with full text.

Z39.50, a bibliographic search language identified by Heterick as one of the keys to this development, was the topic of an article by Lynch in that same issue. After describing the model of the scholar's workstation, he admitted that "the reality today falls hopelessly short of the vision." Describing the potential of Z39.50 to control access and searches on remote databases, he listed the limits of the language, and, more importantly, the limits of the surrounding environment.

> It is essential to recognize that Z39.50 interfaces can only be used in conjunction with other standards ... on data elements and transfer formats. As information server technology comes to be applied to more and more different types of data, it will be necessary to come to rapid, parallel working agreements ... describing the types of data in question.

In closing, we return to the Peters' article cited at the beginning of this chapter. His list of the overarching challenges for the 90s and the information age are a fitting end to this discussion, and an excellent challenge as we face the future emerging from the infrastructure we have built in the past decade:

> Wi.l networked information resources and services ... become as useful as we envision? ... become opportunities available to all who seek to learn and think? ... become familiar and trusted features of the libraries of research and education communities? ... become "fields of dreams" for which the guiding principle will be: "If we build them, the users will come"?

Throughout the march of technology in the last half of the twentieth century, our profession has kept, and must continue to keep, a steady eye on the goal of serving our campus community. To this end, we must ask, as Peters does:

> Why will these benefits contribute to the quality of life and the inspiration of intellect? Without applying this test to our activities and aspirations we can never know whether we are working on the things that can make the greatest difference in the course of human affairs.

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"To be effective, information systems must be kept modular, flexible, and reflective of the organization in which they function. All suggestions for the development of a comprehensive and all-purpose university-wide system should be considered with skepticism."

Wyatt, Fall 1989

2

Information Systems Development and Management

by Sandra T. Dennhardt

The prototype issue of *CAUSE/EFFECT* (January 1978) announced that feature articles published in the magazine would address issues and activities related to three major categories: college and university management and the management of the information systems resource; systems development techniques and management of the development process; and applications systems. Thus it is not surprising that a major focus of the magazine in those early years was on how information systems are developed, used, and managed, and how they in turn support institutional management and decision-making.

In reviewing some of the significant articles published in the magazine related to information systems, several topics presented themselves as logical subdivisions in this area:

- Approaches to Information Systems Development
- Information Systems to Support Academic and Administrative Operations
- Information Systems to Support Management and Decision-Making

Approaches to Information Systems Development

Throughout the decade, approaches to systems development was an abiding concern of the profession and the topic of many *CAUSE/EFFECT* articles. A common objective in many of the articles referenced here was concern over how better systems could be developed faster.

One of the earliest articles to address system design concerns was Alexander's (November 1978) discussion of the design and implementation of an integrated financial control system at Clemson University. We are seeing a resurgence of the issue of integrated systems in the "cross-functional systems" theories that are popular today. Alexander's observations are still pertinent:

> The analysts involved in the design of the financial systems and database must begin by viewing in broad terms the fiscal operation of the University. Ultimately, all systems and information must function as parts of this cycle, and a basic understanding of this cycle is mandatory for those people attempting to structure the data and design these systems. Integrated systems can become a reality only if individual department functions and data are viewed as part of a comprehensive picture.

In his November 1981 article, Patrick recommended beginning the implementation of a new system by first identifying an ideal system model that would permit future improvements as resources became available.

> The first step was to identify the characteristics of an ideal student records system. Then, by applying resource constraints to the characteristics, the committee developed a conceptual design that would fit in our environment and could approach the ideal as resource levels increased.

Characteristics of the ideal system noted by the author were: integrated (common information in central location), cumulative (storing all necessary data), perpetual (reference to data retention), and flexible.

In the early years, some IS organizations attempted to incorporate a highly structured, standards-oriented process for developing applications. Experiences of many IS staff professionals with such approaches have proven that such structure increased the overhead associated with systems development, often without providing the quality enhancement expected. The more recent approaches of fast prototyping, use of CASE tools, and Joint Application Design (JAD) are, hopefully, more likely to improve quality and timeliness of information system development. The latter was the topic of an article by Kent and Smithers (May 1988), in which the authors described how the JAD method works, what results can be expected, how to adapt JAD to an educational environment (it was originally pioneered by IBM

in the early 80s), and how to ensure that JAD produces a successful functional design: "While the JAD technique can be used effectively in almost all stages of systems development, the greatest benefit can be gained via integration with other tools and techniques."

As a mechanism for providing a framework for understanding "a complex, rapidly expanding bundle of computing technologies," Calbos (March 1984) reviewed the evolution of administrative data processing systems at the University of Georgia using several system implementation models.

"The estimation and examination of the life-cycle costs of each application should be part of the organization's strategic planning process for computer systems."

He discussed a number of theories and proposed that the "imminent proliferation of intelligent, sophisticated, powerful word processors and microcomputers may very well call for a re-definition of the stage thesis [of the evolution of data processing]." He concluded with these interesting suggestions for designers of large-scale information systems:

- Do not forget that an information system already exists in every organization. Georgia's began in 1785.
- Periodically take a thoughtful planning perspective on information system building
- Develop a selective strategy for building information systems
- Recognize the existence of political subtleties and pockets of resistance
- Develop a strategy appropriate to the stage [of evolution] and to the understanding of management.

An unresolved question regarding the development of systems is whether it is better to purchase application software or develop it with in-house staff. No defense for either position appears here, but two *CAUSE/EFFECT* articles recognized that many of the same fundamental planning and management principles found in building systems in-house apply as well when purchasing commercial packages.

The importance of planning and identifying a long-range strategy, for example, was emphasized by Sherron and Gattone (November 1983). Their methodology for selection of a library information system for Maryland began with the development of several planning documents or proposals:

> A master plan was developed which addressed the long-range plans for the use of computing in libraries. ... In addition, the University libraries developed a five-year plan which, while addressing automation, primarily focused on the services the libraries expected to provide.

Only after this groundwork was laid was an RFP prepared, which included a list of mandatory requirements to be used in vendor evaluation. The technical evaluation was followed by the financial evaluation and the selection analysis. The authors noted that "the actual carefully worked out procedure ... provided the framework whereby the University libraries were able to evaluate proposed products against a list of agreed-upon needs."

Haugen and Nedwek (Winter 1988) applied the use of prototyping and simulation as decision tools in the implementation of purchased software, noting: "Purchased software is not an 'off-the-shelf' solution, and implementation must be viewed as a system development process."

> While usually associated with traditional system development efforts, prototyping also has application within a purchased-software implementation ... to integrate the purchased software and associated training with system analysis requirements and to develop a final product focus. ... A prototype was created combining the purchased software with a functional [St. Louis University] database. There were three important outcomes: decisions were forced, procedural assumptions disappeared, and teams were sensitized to the importance of interteam coordination and communication. A simulated registration using students and office personnel was carried out to test final design decisions. The simulations validated policies and procedures from both service provider and client group perspectives.

By the end of the decade, many colleges and universities that had been on the forefront in developing administrative information systems were finding those aging systems were no longer able to serve the changing needs of users. Heller (Summer 1990) addressed an important strategic approach to replacement of aging systems in his article about system revitalization at MIT. He began with these interesting observations on system life cycle costs for maintenance:

> The commonly held belief among many information technology professionals is that the systems life-cycle costs for application development and maintenance costs ... are heavy during development and comparatively minimal for maintenance. As an application ages, the real dollar cost to maintain and operate it usually increases each year. If the real dollar cost of maintaining an older system is not increasing annually, then one should examine whether or not all maintenance requests are being met on a timely basis. ... The estimation and examination of the life-cycle costs of each application should be part of the organization's strategic planning process for computer systems.

Heller reviewed a remodeling project that included a major restructuring of a database resulting in several significant improvements. He concluded: "By extending the life of the system and postponing the capital expense of replacing it, we have made resources available to address priorities in other areas."

Applications to Support Academic and Administrative Operations

Information systems support academic and administrative functions on campus, and increasingly the campus community has come to realize that the library of the future will be managed through automated information systems as well. Many innovative applications have been developed on college and university campuses, some of which have been shared through *CAUSE/EFFECT* articles.

An early innovative application at the West Virginia University School of Dentistry, the Omnibus Dental Online Treatment and Information Control System (ODONTICS), was the subject of an article by Graham, Biddington, Richmond, and Sizemore (July 1982), who later that year became the recipients of the 1982 *CAUSE/EFFECT* Contributor of the Year Award for their article. According to the authors,

> ODONTICS has fulfilled the principal goal for which it was designed, i.e., the enhancement of quality assurance in a clinical teaching program that mixes comprehensive patient care with a departmental organization. In addition it has shown itself to be very promising in numerous areas of administration as well as educational and institutional research.

On the academic side, student systems of all kinds have enjoyed much of the limelight in *CAUSE/EFFECT*. The direct impact of a computer system on the educational process was the topic of an article by Edwards, Costello, and Gallagher (November 1981). Minicomputer information systems were developed to computerize the data collection required to manage medical student field encounters and to provide a testing system to measure the student experiences. One of the end products was a transcript, with meaningful documentation of all clinical encounters, which was prepared for each student at the time of graduation. The authors noted that "this experience has enriched the professional life of ... program staff by providing a deeper appreciation for the potential value of computers in medical education." The systems were considered to be "important interlocking components of the educational program" at Nebraska. In addition, the project demonstrated the "potential for cost savings ... by widespread use of such a jointly developed and distributed system."

Two *CAUSE/EFFECT* articles related to student IDs have demonstrated innovative uses of technology. The first article, by Ridenour and Ferguson (March 1986), described the development of an early machine-readable student ID card system which relied on up-to-date computer-stored data for validation rather than the possession of a once-validated card. This eliminated the requirement for several ID cards and provided for real-time validation of student status. It is interesting to compare this to the more recent use of a bank card as a multi-function campus ID card at Florida State University, described by James and Norwood (Summer 1991). This project merged several technologies to make possible the ACCESS card—simultaneously a bank ATM card, a student ID card, and a debit card—which resulted in many unexpected benefits and promised even more in the future.

Boston College also developed a system that addressed the student's needs and provided direct service delivery by the creative application of technology used in the commercial environment. Springfield (Winter 1990) described the U-VIEW system, which allowed students to display and print their campus records at automated teller machines located throughout the university. ATM technology solved the problem of durable, secure, and easy to use equipment. The author anticipated additional uses of this technology, noting: "The ATM has proven to be an effective way to distribute information to students, free administrators of tedious tasks, and generally improve the quality of life at Boston College."

"The ATM has proven to be an effective way to distribute information to students, free administrators of tedious tasks, and generally improve the quality of life at Boston College."

A major break-through in student-related applications was documented by Rasband, Childs, and Tomlinson (March 1986) in an article that featured the first campus development and implementation of touch-tone registration, at Brigham Young University. The authors noted that "with students doing their own data entry, the registration office experienced an increase in telephone calls [and] the staff now found themselves interacting with people rather than with computer terminals." By the end of the decade, dozens of campuses were following BYU's lead in efforts to more effectively serve students through voice response systems.

As microcomputers were introduced to campuses around the country, articles documenting how the new technology was being applied appeared in *CAUSE/EFFECT*. In many cases, the first administrative usage, beyond stand-alone spreadsheets and word processing, involved the development of decision support systems. Decision support financial modeling systems using microcomputers were the topics of articles by Brown and Droegemueller (July 1983) and Cloutier and Hoffman (January 1985). In July 1985, Shumate reported a similar implementation which had the added advantage of mainframe connectivity.

Information Systems to Support Campus Management

Management information systems (MIS) proponents have emphasized the importance of IS supporting management and decision-making in the corporate world, and many *CAUSE/EFFECT* authors throughout the decade have consistently worked to relate MIS concepts to higher education planning and management. In one of the earliest of these, Gardner and Parker (May 1978) concluded that the value of MIS in higher education was their potential utility in effective

"Credibility of the information will be less than or equal to the credibility of the weakest database."

political position building rather than conventional management problem solving:

> If the idea that information is needed to manage, i.e., to improve unilateral decisions (problem solve), can be discarded, focus of system development efforts can shift to production of information useful in the political processes by which the institutions are actually governed.

In a similar probe, Bryson and Posey (July 1980) raised policy questions concerning whether the development of statewide data systems was effective. A number of their comments remain relevant today:

- Instead of meeting information needs, statewide systems are generally characterized by an information lag.
- The range of problems found in various statewide data systems suggests that the source of discord is more human than technical.
- While many statewide data systems were developed in response to anticipated needs for accountability, in reality they often gather massive amounts of data that are rarely interpreted for administrative or managerial use. Perhaps in the 80s more emphasis can be placed upon efforts to develop realistic assumptions to make statewide data systems relevant, usable, and accountable.
- Reassessment of large-scale data systems in higher education should deal primarily with underlying policy assumptions and human factors and avoid tendencies to concentrate on technical methods of implementation.

Several articles addressed the importance of understanding and supporting the enterprise in which the information systems were being developed, especially the culture and organization of the campus and how they affect, and are affected by, information systems. Fox and Groff (July 1979) proposed:

> Mission and purpose are the core for all institutional goals and ... data modules are interrelated with each other and should be supportive of the institutional goals. Data play an important role in the planning process as well as in the management and evaluating functions. Data are needed: (1) about environmental assumptions upon which to base planning; (2) about potential clients and unmet societal needs growing out of a needs assessment or market analysis/market segmentation process; and (3) for managing those institutional areas just specified. The data analysis process must strive to produce meaning as it relates to efficiency and effectiveness of relating dollars to institutional goals and objectives.

Arns (September 1979) also recognized the need to understand the enterprise for IS to support campus administration. He described a model to illustrate administrative relationships within his university, and explored the influence of organizational characteristics on the functioning of the institution to determine principles for the design and application of information systems.

> One of the most noteworthy characteristics of a university is the existence of an organizational structure which differs markedly from the program structure. Formal communication in the university tends to follow the structural (bureaucratic) lines and such communication is believed to be notoriously poor. The way in which information is organized and presented influences behavior, whether or not that is the intention.

Arns itemized principles for the design of management information systems, being sensitive to institutional needs as well as those of the administrators using the systems:

a. Keep the presentation of information clear and simple
b. Credibility of the information will be less than or equal to the credibility of the weakest database
c. Display as little as is possible to decrease the danger of information overload
d. When possible, valid extramural information should be part of the official internal information system
e. The official organizational communication system should present the same information to each administrator
f. The design of information systems should not block comparison with information from an earlier period

Much later, Wyatt (Fall 1989) discussed information systems as potentially a "trusted colleague" to decision-makers, noting the need for these information systems to reflect the organizations they serve. He noted that universities differ from their business counterparts in their heterogeneous management styles and organizational structure. "To be effective, information systems must be kept modular, flexible, and reflective of the organization in which they function." Wyatt suggested rules for information system development, including: (a) decision-makers using management systems should be involved in their development; (b) data must reflect the individual institutional situation at the highest level of aggregation possible; (c) systems must have executive mentors, leaders in the executive ranks who keep the system relevant; (d) information systems should stick to the straightforward and understandable; (e) all suggestions for the development of a comprehensive and all-purpose university-wide system should be considered with skepticism.

Arns and Curran (September 1983) proposed that the survival and success of an organization depend in large measure on the extent to which it looks to the future, noting that the information needed for decision-making depends upon the kinds of decisions being made—from strategic

planning, through tactical planning management control, to operational control, noting that "the Management Information Systems (MIS) of most organizations are designed for operational control." The authors made these observations about developing information systems for strategic planning:

> Because of the need to provide new information on short notice and to change the organization of information frequently, we have avoided "production" systems for strategic planning or tactical planning/management control applications. Sensitivity to strategic planning/implementation considerations at the level of production systems has been mainly directed to issues of data element definition and to data integrity. We have experienced the need for kinds of information not previously gathered—much of it from outside of the institution—[and] have found the availability of a non-procedural application development language and of a strong statistical package essential.

Miselis (Summer 1989) viewed information systems as a "key unifying force" for campuses, and identified the need for information systems professionals to gain more expertise in planning and planning processes. She concluded with three results to be gained by moving aggressively forward with integrated planning and information resource management:

- Greatly improved institution-wide strategic planning and management
- Greater understanding of both academic and administrative information as a strategic institutional resource
- Greater cooperation between the significant organizational units involved in planning, to produce stronger and more unified support for the institution's strategic plan.

The importance of establishing an "information architecture" as the basis for building information systems to support the management/decision-making process has been and still is an important IS topic. Two articles from *CAUSE/EFFECT*—published eight years apart—represent this philosophy well. The first, written by Craft and Legere (March 1983), described a process analysis method, using matrices to identify functions, primary responsibilities, and the information flow in order to analyze and define system needs. The second article, by Vogel and Wetherbe (Summer 1991), recommended avoiding the development of fragmented, piecemeal systems by studying the overall information requirements of an organization and developing an architecture to provide a "road map" for developing various information systems that must be tied together. Their methodology included the creation of an analytical planning model consisting of nine stages. The authors described the use of process matrices reminiscent of those proposed by Craft and Legere (though more detailed) for recording and analyzing the information collected as the planning model is followed.

Finally, an article by Quinn, published more than a decade ago (May 1979), addressed a topic that is enjoying a lot of attention in today's business literature and relates to the "responsibility center management" approach that has emerged on some university campuses. Quinn's article described Alfred University's forward-looking policy of decentralizing decision-making throughout the university by providing more information to all levels of decision-makers. Key systems were rewritten at Alfred to provide the necessary

"Good technology may establish sufficiency in meeting functional DSS requirements, but it does not assure success."

additional reporting to support this philosophy. The author closed with this comment: "It is a natural tendency for top management to keep control of decision-making closer to the top as resources become more scarce. The methodology described here requires just the opposite—decentralized management with more decision-making and control to lower level management."

Decision Support Systems

As the term "decision support systems" (DSS) began to be used, articles appeared in *CAUSE/EFFECT* documenting the experience of higher education professionals in developing this new type of planning system. An outstanding article by Chaffee (May 1982) described information systems developed at Stanford to support decision processes. After briefly identifying the four major models of decision-making theory, Chaffee concentrated on the model of the rational decision-makers who "use information to identify the alternatives with maximum cost-benefit ratios." The article concluded,

> If information specialists wish to foster a rational process, the Stanford experience provides them with some suggestions. Information specialists can seek to provide a chronological skeleton to the problem-solving process. This helps to define values before analyzing alternatives. Further, it ensures that the preparation of information anticipates, rather than follows, the information needs of decision-makers. Information is more useful ... if it exhibits two additional features: 1) the processing of information should call attention to that which is not known; and 2) the development of information should yield conceptual tools that decision-makers and others who must cooperate can use to motivate actions congruent with the decision.

In an article that introduced the September 1982 issue of *CAUSE/EFFECT*, which focused on DSS, Roberts noted that the central theme of DSS has been one of creating a means whereby computer and information technology can assist the management process of decision-making:

"After technology improves our efficiency, it changes the way we do things."

> Conventional data processing applications are almost exclusively the repository of information concerning events that have already occurred, or are programmed to occur in a highly structured fashion. Decision Support Systems, on the other hand, are designed to look forward in time, to forecast outcomes of uncertain events. [A] new generation of technology has gone far to overcome the centrist model of organizational dynamics which was forced on many problem and decision situations in the past by the economies of scale of large mainframe computers. Good technology may establish sufficiency in meeting functional DSS requirements, but it does not assure success.

In another article from the DSS focus issue, Chachra and Heterick noted the basic attributes that should characterize a decision support system: "The DSS must allow the decision-maker to personalize, modify, and augment if it is to achieve the coupling of the individual with the machine.... The value of a DSS is directly proportional to the information sources to which it has access, and the ease with which these sources may be accessed and manipulated."

In discussing the use of quantitative information in higher education decision-making, Harris (July 1984) stressed the need to realize that decision support tools are intended for the support of decision-making, not as a replacement of the decision-making process.

> We [information systems managers] must become role models of managers who are able to use quantitative instruments in decision-making, as well as promoters and educators of such tools. I found that those who were successful in modeling ... possess a desire to address the issues of the day in a new way and had an openness to approach problems from a new angle. Users of computer-generated information need to be educated about the form in which such quantitative information is kept and how it can be accessed. Decision-makers who can "call the shots" as to what information is acquired (and in what form) for a particular decision do not feel as uneasy about using such information.

Penrod and Wasileski (January 1985) observed that their implementation of DSS at Pepperdine University provided a shopping list of decision support tools through interface software residing at all three levels of hardware—mainframe, minicomputer, and microcomputer. They defined DSS as having four components: relational data files, models, solvers (language or program for executing a model), and interface facilities (communications network).

Microcomputers were an integral part of the DSS described by Sapp and Temares (September 1985). They used three major decision support systems: micro-generated graphs to summarize data about the internal and external environments, projection models of project enrollment, credit hours, etc., and Program Evaluation and Review Technique/Critical Path Method (PERT/CPM) to address problems of scheduling and responsibility in the planning process. The article concluded with a number of recommendations, such as keeping all models simple and flexible.

Executive Information Systems

By the end of the 80s, a new information system concept had emerged, viewed by many as the next logical step in the evolution of MIS. Executive information systems (EIS) were the focus of the Fall 1989 issue of *CAUSE/EFFECT*. An article from that issue by Viehland provided an excellent definition for EIS:

> The distinguishing characteristic of an executive information system is that the end user is the executive. In theory, DSS are designed for decision-makers, including senior management. In reality, it is usually the budget officer, institutional researcher, or the president's assistant who uses the system to answer executive officers' inquiries. In an EIS there is no doubt who uses the system—the executive.

Viehland noted that an executive information system must be "executive friendly," must meet the needs in terms of speed, and must be graphic-oriented:

> In other ways an EIS is a natural evolutionary advancement of what a decision support system was always supposed to be. A decision support system allows a user to obtain data from an "information support data base" and organize that data in a meaningful manner so the data become information. An exception DSS, or an ordinary EIS, goes several steps further. An executive ... may "drill down" in order to discover exceptions ... [or] compare this year with previous years or with peer institutions.

Viehland further noted that an EIS does not stand alone, but functions as the central, core portion of a broader executive support system (ESS) which comprises three separate, but overlapping, components: mental modeling, executive information system, office automation support.

The Fall 1989 *CAUSE/EFFECT* also featured Ryland's interview with John F. Rockart regarding EIS, whose comments reinforced the definitions provided by Viehland: "The whole world of DSS has really collapsed into any system aimed at helping somebody get to and manipulate data." Rockart emphasized the fact that the functions of an executive are different from the functions of lower level managers, and therefore require executive systems to be more responsive, simpler, and easier to use: "It is important to separate out the function of executive support from decision support."

Conclusion

This chapter began with the emphasis on system design and innovative application systems, and has ended with a

discussion of information systems to support management, decision-making, and executive direction setting. As we are all aware, the technology we use is changing at an ever accelerating pace, as are the needs of the clients information specialists serve. What will be the emphasis of tomorrow's information systems? How can we position our system implementations to be ready for the future? An article by McLaughlin, from the special Fall 1989 EIS-focused issue of *CAUSE/EFFECT*, provided a good summary of the topics covered here, and proposed some direction for the future. Observing that support systems cannot work without the presence of a solid foundation of valid and reliable data, he suggested:

> We need to build our information support on solid [data administration/database administration and] to educate others about the need to coordinate information support with policies and resources to prevent ... either ignoring the needs of the institution or basing decisions on unreliable and invalid information. We need to focus our efforts on learning how to better provide information support based on the amount of structure in the situation, rather than the specific group of individuals. Technology is seeking to network knowledge in intelligent devices that will be part of our functional products. Flexible organizations with downsized management and technical staffs will emerge. After technology improves our efficiency, it changes the way we do things. We need to continue to provide the means to listen and think and to absorb information overload. If we build our capabilities on knowledge of information use and share that knowledge through professional networks, then we will be in a strong position to meet the challenges of the future.

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"Whatever the management structure, someone must provide campus-wide leadership and set the strategic direction for the use of information technology in the context of institutional mission and direction."
Smallen and Ryland, Summer 1989

3
Organizational Structure for Managing Information Technology

by Robert R. Blackmun

Reflecting the interest of its readers, *CAUSE/EFFECT* has consistently published many outstanding, thought-provoking articles on issues relating to organizational structure for managing information technology, including the Campus Computing Environments section in every issue. These articles and features have helped CAUSE members develop an understanding that organizational structure is increasingly a "critical success factor," particularly in addressing the evolving needs of end users and the converging technologies.

The outstanding articles on organizational structure that have been published in *CAUSE/EFFECT* can be grouped into several major themes:

- Centralization vs. decentralization of computing and communications services for both academic and administrative functions and users, reflecting our continuing efforts to balance the needs of specific individuals and departments and the overall needs and resources of our institutions
- Campus information technology organization structures, including articles describing specific information technology organizations as well as strategies for creating and redefining organizations that effectively and efficiently meet changing needs
- The Chief Information Officer (CIO) issue and its impact on and importance to our efforts to plan and manage the effective use of information technology

One common idea appears throughout these articles: the primary catalysts for change in our organizations have been the merging of information technologies and the continual increase in and demand for end-user access to information.

Centralization vs. Decentralization

The issue of centralization vs. decentralization has been the subject of considerable attention in our field, although it is not unique to either information technology or to higher education. In a September 1979 *CAUSE/EFFECT* National Issues department piece, Heydinger and Norris quoted John Gardner from a *Chronicle of Higher Education* article: "A root disease of bureaucracy is the tendency to centralization. In a well designed government, there would be a wide and fitting allocation of functions between the center and the periphery." Kriegbaum (July 1982) paraphrased Alvin Toffler in arguing for a decentralized approach to information technology:

> Toffler suggests that centralization is one of the typical emphases of the industrial mindset. It emphasizes control from the top down, and seeks to gain the efficiencies often provided by standardized procedures and good internal coordination. In the centralized arrangement, the vertical line relationships are the ones that really matter. ... By contrast, a decentralized approach, which Toffler claims is more characteristic of the high technology information society, depends upon the free flow of information to promote effective decisions that are made as close as possible to the point of implementation.

Mathezer (July 1985) devoted considerable attention to the centralization vs. decentralization issue in his article about Mount Royal College's implementation of an institutional framework for managing and using information technologies. He identified three aspects of the issue:

- *Control*, or the locus of decision-making power;
- *Location*, or the physical siting of facilities; and
- *Function*, or the position of a given responsibility within the organization (e.g., central vs. distributed programming or accounting function).

Mathezer believed that "it all boils down to a trade-off between *efficiency* and *effectiveness*. The former stands for the organizational advantages of control, uniform quality, economies of scale, while the latter is the symbol for user

needs, local productivity, greater initiative, etc."

It is interesting to note that Heydinger and Norris advocated decentralization defined in terms of end-user access, rather than physical location of the equipment:

> Decentralization provides computation capabilities and data access to end users. Whether the device actually performing the computation is physically located near the end user is irrelevant. ... Another essential characteristic is that the users have access to the system at their request, not at the choice of some other party.

These authors defined many of the issues that would become increasingly important to information technology managers' efforts to provide effective organizational structures, including the increased need for standards to ensure compatibility and comparability and the importance of recognizing the varying needs of academic and administrative users and involving both groups in planning. They also identified the conflict between the fact that "as the price of computing comes within reach of the individual, there will be an explosion in the development of specialized software packages," and the view that "the equation of resources in computing has changed; personnel costs are now more significant than hardware costs. The focus among many supporters of decentralization remains on the declining costs of hardware and software, not the rising costs of personnel."

"Decentralization can result in parochial views with little concern being given to the university-wide computer infrastructure."

The definition of decentralization in terms of end-user access was also apparent in Olson's (January 1986) description of an information systems support unit in the admissions and financial aid office at the University of Southern California. His article dealt with "consolidation" of resources and local support of users through the creation of Administrative Information Resource Systems (AIRS). While Olson dealt with AIRS as a decentralized unit from the perspective of the overall institution, he also identified some of the significant challenges and benefits of centralization from the perspective of an administrative office providing support to a growing number of distributed end users outside that office, including increased user expectations and demand for support.

Echoing the earlier emphasis on coordination, Olson also focused on the importance of cooperation between the central computing organization and administrative offices, the fact that limited and complex end-user software tools available at the time had a significant impact on "personnel" issues, and the need to ensure comparable salaries for programmers working in central organizations and individuals functioning as programmers in departmental offices: "Until the end-user tools are usable and productive enough so that users can continue their normal jobs while taking advantage of the new tools, we should call a programmer a programmer."

In their article about institution-wide coordination of decentralized computing, Alley, Shaub and Willits (March 1987) stressed that decentralization is inevitable; thus our attention must focus on when and how, rather than whether, to decentralize:

> Given that computing will decentralize, management's prerogatives are limited to: (1) how rapidly the distribution of computing will evolve; and (2) how positively or negatively that evolution may affect the ultimate administrative functions of the institution.
>
> What can happen when decentralization is not coordinated at the institutional level? In his article about decentralized computing at the operational level, Muffo (Winter 1989) reported the results of an internal study conducted at a large, prominent research university of the computing activities at one of the university's academic colleges.
>
> The study found that many of the problems formerly resolved at the university level now had to be dealt with at the college and departmental level. The advantage of increased control in the decentralized environment was offset, at least in part, by the lack of experience in planning for computing at the academic and administrative operating levels.

Muffo identified vendor discounts and software site licenses, networking, databases, supercomputing, and other rapid changes in technology as reasons that "colleges and universities have discovered the need for centralized computing services in decentralized environments." The college-level study identified problems similar to centralized computing issues, including supervision of staff and the need for "colleges and departments to develop their own computing plans, including the budgetary components." Muffo summarized the overall situation in terms of policy issues:

> In the college study, we found that it was more the lack of computing policies, rather than disagreement with existing policies, that seemed to cause the most concern. Most of the difficulties arose from a lack of coordination.

The article concluded with a "challenge to the profession" to "develop formal and informal mechanisms to assist operational units in developing appropriate and effective policies and procedures for computing without taking back the responsibility for it."

> This is a new role for most, quite different from that of the technician or the former "czar" whose job was to allocate. So, while the problems seem familiar, the role of the computer professional in solving them is new and different.

Similar issues were addressed in Kettinger's Fall 1990 award-winning article on decentralization of academic computing, written from the perspective of an assistant dean responsible for a college-level computing organization providing decentralized support within a large university. Ac-

cording to Kettinger, with decentralization, users believe that they are at the locus of control, that they have at their disposal a myriad of computing options, and that they can be judicious consumers. He identified several problems with decentralized academic computing that are similar to those cited by previous articles, including the possibilities that:

- decentralization can result in parochial views with little concern being given to the university-wide computer infrastructure;
- campus-wide mechanisms to effectively coordinate computer and telecommunication resources in a decentralized environment do not exist;
- with greater scope and complexity of decentralized computer operations comes the need for more support personnel and associated operating budgets for new equipment and maintenance support; and
- decentralized computing staff may feel isolated from their computer colleagues and their upward mobility may be stifled in smaller departmental or college support organizations.

Other possible disadvantages of decentralization he noted included user responsibility for their own backup, security, and updates of the individual programs and data sets and those large proprietary databases used in research that reside on departmental and individual machines, and greatly increased diversity of equipment and software on campus. Despite these challenges, he presented a strong case for decentralization based on the advantages of discipline-specific support, including more effective support for the academic mission based on improved knowledge of the discipline, increased user productivity, greater computer integration into the curriculum, and demonstration of a high level of faculty support as a means to both attract and retain quality faculty.

According to Kettinger, the provision of discipline-specific support requires new roles for the computing center:

> ... the computer center will be responsible for operating mainframe computers for university administration and providing mainframe processing for those academic departments that do not possess their own departmental mainframes or minicomputers [and for] facilitating coordination by organizing policy-making activities and providing technical advisement ...

as well as new roles for the departmental center as the "focus of academic computing":

> Specialization of both hardware and software will continue to require discipline knowledge to support increasingly complex instructional and research computer applications. ... [M]ore and more new computer support personnel [will be located] within departments [and will be the] principal contact for computer users with problems and will act as the liaison between the department and the university concerning computer policy ...

and new roles for individual users: "autonomous computer users must now take responsibility for developing their own applications as well as for maintenance, backup, and security of their data." Kettinger's conclusion summarized our changing view of decentralization:

> ... the new posture of the central computer organization requires moving from a reactive-operational role to a proactive-leadership stance [and] the central computing organization must become information resource planners, facilitators, and technical consultants.

"The new posture of the central computer organization requires moving from a reactive-operational role to a proactive-leadership stance ... "

Campus Information Technology Organizational Structures

A number of excellent articles on general issues of organizational strategies have been published in *CAUSE/EFFECT*. Concerned primarily with organizational models to support end-user computing, Blackmun, Hunter, and Parker (Fall 1988) described the characteristics, advantages, and disadvantages of four organizational models: end-user computing support in MIS, end-user computer support centralized outside MIS, the Information Resource Center, and function or discipline-oriented support. After relating Richard Nolan's Stages Theory of technology assimilation to the convergence of technologies, the authors described an organizational model for information services that had been proposed by Robert Zmud which combined "decentralized 'entrepreneurial information-related behaviors by business units' with centralized planning, control, and support of technologies."

> The local units provide functional/discipline related support, while central units "insure that these behaviors are not detrimental to the enterprise's information technology posture in either the short or long run."
>
> The two essential ingredients in both implementations are the provision of first line, distributed support staff who are familiar with the particular needs and capabilities of a group of faculty or staff members, and a second line, centralized support staff who are familiar with a variety of technologies which can be used to meet the needs of various end users.

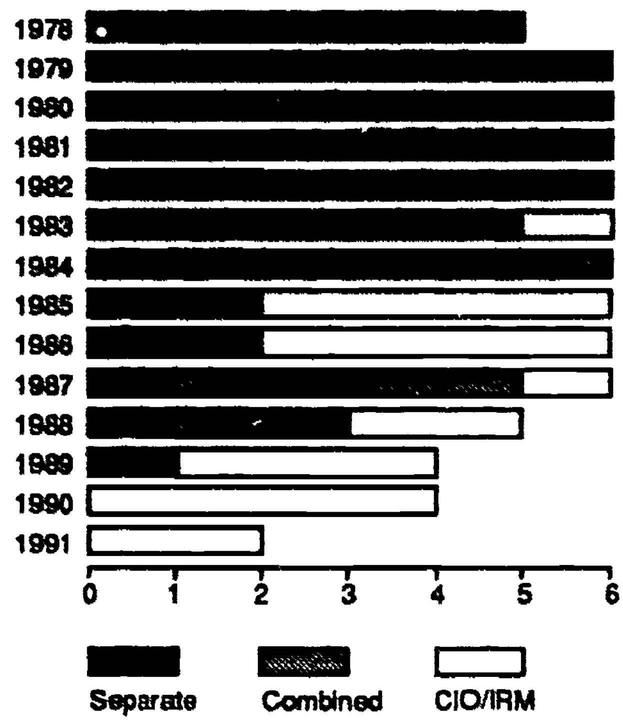
Just as the rise of end-user computing prompted discussions of how to organize to serve this growing segment of the campus community, so the merging of computing and communications technology gave rise to the recognition that organizational changes would be necessary to deal with the resulting management issues. Creutz (May 1986) offered sound advice in this regard:

> The ideal telecommunications organization is centralized. All telecommunications issues should be handled

Campus Computing Environments

In addition to articles providing overall organizational models and strategies, *CAUSE/EFFECT* has provided readers with a view of the information technology organizations at a variety of campuses through the Campus Computing Environments section in each issue. The campuses featured in this section have included the full range of institutions—from small, private liberal arts colleges to single and multi-campus community colleges to medium-sized public and private universities to the largest public and private research universities. Similarly, a full range of information technology organizational structures has been represented, including highly autonomous academic and administrative computing centers, combined computing services organizations, and organizations designed to fully integrate information resource management functions under a chief information officer.

Campus Computing Environments
March 1978 — Summer 1991



An examination of the organizations featured in this section of *CAUSE/EFFECT* each year (see figure) reveals a high level of interest in "combined" academic and administrative organizations through 1984. Subsequently, organizations that integrate information resource management under a chief information officer received increasing attention. It is particularly interesting to note that, in the period through 1984, many of the campuses having "separate" organizations were medium-to-large institutions, while many small-to-medium sized institutions had "combined" organizations, perhaps due largely to budget considerations. However, since 1985 the featured campuses that had or were changing to combined or CIO/IRM-type organizations consistently have included all sizes and types of institutions. In the same period of time, the information about campus organizations has evolved to include descriptions of the overall mission and the planning approaches that have been used to successfully use information technology in support of institutional goals.

in one office, and these issues include planning, engineering, performance, operations, maintenance, and procurement for both telephones and data communications. In addition, it has top-level visibility, ideally with a direct reporting relationship to senior institutional management.

The telecommunications office must not only handle the day-to-day mechanics of running your systems and switches and networks, it must also provide a support structure for the entire institution's communications purchases.

Lilly reported on Virginia Tech's newly created Communications Network Services (CNS) organization in a July 1985 article that discussed mission, rationale, and goals for CNS. The new organization resulted in the "integration of all voice and data communications activities, including management, acquisition, distribution, and maintenance of intelligent workstation facilities." CNS was created to:

- ensure the continued availability of basic, reliable, and competitively priced communications services
- ensure the availability of advanced functional capabilities in state-of-the-art communications systems which are critical in overcoming the geographical isolation of Virginia Tech
- develop and maintain a five-year plan for the acquisition, development, and management of a consolidated University communications utility.

Reflecting emerging theory in the corporate sector that flatter organizations are more appropriate in the information age, Barone's article about the need for more flexible organizations in higher education (November 1987) advocated a matrix management or "contingency approach" to organizational structure to cope with what she termed the "computing convulsion." She described the approach developed at Syracuse University to respond to planning for converging technologies thus:

Under the contingency approach, organizational structures are determined by the existing mixture of computing equipment on campus, the institution's computing plan, the culture of the institution, and the strategy chosen to achieve the institution's goals.

Based on the author's experience, there were both advantages and challenges with this approach:

> In contrast to traditional structures that support a static environment, a matrix structure employed in a contingency approach to management permits the targeting of resources more effectively, the elimination of overlap and duplication, and the strengthening of weak areas. [It] encourages a blending of organizational units, and the crossing of organizational barriers; it emphasizes the achievement of specific goals, and recognizes rapid change in the environment.
>
> The contingency design, however, presents a leadership challenge to avoid confusion regarding responsibilities, turf battles, buck passing, and other dysfunctional behaviors. Cooperation and communications are essential.

Barone identified key benefits to both staff members and users, including "foster[ing] among the staff a far broader understanding of and appreciation for the academic and administrative goals of the University."

In a Winter 1990 Viewpoint article, Davis summarized an organizational paradox facing the profession, also echoing themes from the corporate sector:

> IS is being asked to move in opposite directions at the same time—to disperse control by flattening and spreading out the information management structure, while implementing increasingly complicated, integrated systems which physically and logically span the organization, and require a great deal of coordination.

Davis described three objectives for the information technology organization in dealing with this paradox: (1) "... establish an enterprise model which describes how information flows through the organization [to] promote understanding of how and where information is used, and provide the basis for planning"; (2) use "the information gained from the enterprise model to coordinate the deployment of information resources throughout the organization"; and (3) adopt "industry-wide, open standards wherever practical."

Two other recent articles have dealt with organizational issues based on the continued evolution of both the business environment and technology. Nolan (Winter 1990) illustrated the benefits of the network organization as a replacement for the functional hierarchy:

> Apple Computer offers a good example of the importance of shadow networks. As a new organization, Apple doesn't have all the "baggage" that some other organizations have. Nevertheless, it has embraced the idea of the network as a preferred structure, and has put into operation a number of related ideas, such as: modular groups instead of traditional marketing and manufacturing functions, task-driven operations, management by dissent, organic organizations rather than fixed organizations, a global network, a global Apple knowledge base, and a global executive information system. It has embraced this philosophy formally and has begun a strategy to get there.

Nolan cited the dramatic differences in sales per employee between Apple Computer and two other "well managed companies" as examples of the benefits of "establishing a different paradigm."

The conclusion to Freeman and York's article about client/server architecture (Spring 1991) described the organizational impact of this new model:

> The shape of the IT organization must also change. The tradition of separate and fully self-sufficient administrative and academic computing units will no longer be appropriate. Institutions cannot afford to fund multiple staffs for networking, operations, workstation development, and so forth. Nor can they wait for ultimate client/server standards and technology solutions before developing new support infrastructures. Neither the centralized support paradigm that worked with hierarchical mainframe computing, nor the decentralized model of the mid-1980s that emerged to support widely dispersed microcomputers, will be sufficient. Just as client/server architecture implies that processing is done on a distributed basis (i.e., where it can be done most efficiently), end-user, network, and application development support will also have to work on a distributed model with some functions performed centrally and others at the local user sites. The viability of the client/server architecture will ultimately depend on the willingness and ability of central information technology staff and user groups to reorganize into cooperative teams to support the new architectures.

"Neither the centralized support paradigm that worked with hierarchical mainframe computing, nor the decentralized model of the mid-1980s that emerged to support widely dispersed microcomputers, will be sufficient."

Rise of the CIO

In addition to articles on organizational strategies and structures, *CAUSE/EFFECT* has published articles on the specific issues relating to Chief Information Officers (CIOs), often related to Information Resource Management (IRM) organizations.

In the first *CAUSE/EFFECT* article to suggest the concept of an "information officer," Kriegbaum (September 1980) defined the role of what he termed "the management information officer" in decision-making:

"Pulling all the information and communication functions of the campus together under one coordinator should promote the comprehensive system solutions that colleges will need in order to remain competitive."

> ... when proactive decision-making will be essential to the pursuit of excellence, and in some case to sheer survival, a management information officer may continue to emerge as chief coordinator. ... This officer serves the institution by identifying, clarifying, informing and coordinating key institutional decisions. He/she takes a leadership role in the process of finding a good fit between each decision and the decision process paradigm within which the decision is make. ... The role of the management information officer is to identify key decisions which the college must face, and to structure them as understandable system events. ... He/she helps the organization clarify who is deciding what, when the decision will be made and how it will be made. ... Several factors have been converging to create the need for a management information officer who does not make key decisions, but who is aggressively and significantly involved in identifying, clarifying, informing, and coordinating key institutional decisions.

A year later, two other authors, taking a slightly different approach, described a functional organization that would support integration and cooperation among information technology support units.

Robinson (September 1981) reported the recommendations of the "Working Party," a group of leaders from higher education, industry, and professional associations who had met to discuss the future of information technology and the options and opportunities it offered higher education. Among their recommendations was the possible creation by campuses of an information resources and systems organization that would "join together many of the organizations and functions presently charged with aspects of corporate information management." Listed among those were computing, the campus communications network (including video, telephone, and data networks), interoffice mail service, the media center, campus printing and reproduction services, and the campus library.

Heterick (November 1981) wrote,

> Some of the information disseminating and facilitating offices on most campuses would include the Library, the Computing Center, the Learning Resources Center, the mail center, copy centers, print and photo shops, and the telecommunications center. Each of these organizations has a particular area of experience and expertise and shares a common goal of cost-effective information dissemination. On many campuses some report through academic channels, some through administrative channels. A strong case could be made for structuring the organization such that these offices reported through the same channel, encouraging the synergy necessary to seize the opportunity to mold an information intensive university.
>
> The problem is not so much to manage these people (in fact, this is probably exactly the wrong thing to do) as it is to manage the physical environment and communication links that tie them together.

Having proposed in his earlier article that the management information officer not make the institution's key information decisions, Kriegbaum proposed in a second article (July 1982) that line responsibility be consolidated to maximize efficiency and competitiveness, approaching more closely the IRM organizational model:

> The best organizational model would place all the information and communication systems of the college under one cabinet level administrator with a mandate to make them as integrated, efficient, and flexible as possible. This approach accepts the college as a knowledge organization in the context of a high technology information society. The areas normally included would be the library, the registrar's office, instructional media, phone and mail services, institutional research, marketing research, data processing, word processing, and all operational and strategic management report systems. Pulling all the information and communication functions of the campus together under one coordinator should promote the comprehensive system solutions that colleges will need in order to remain competitive.
>
> The college that will prevail as a knowledge organization in a high technology, post-industrial society will move purposefully toward the creating of an electronically integrated campus with as little paper as possible and with as much free access to as much on and off campus information as funds will allow. Such a college will be reducing the proportion of budget spent on people to do low level clerical tasks and increasing the dollar investment per person in information and communication technology. Such a college will reduce organizational barriers to the free flow of information and ideas by placing all of these systems under one administrator.

Based on observations of a number of institutions that had chosen to establish a chief information officer position, Fleit's May 1986 article expressed concern about the objectives and characteristics for success of such an endeavor:

> ... the impetus to have a computer czar was to be able to continue to allow all of the other top-level people to avoid learning what they themselves needed to know about technology. They wanted all of the responsibility in one place and in one position, so that they didn't have to deal with it.

The author described several important traits that need to be present to increase the chances for success:

> The first trait is a well-thought-out position on computing, resulting from a great deal of experience, including having made some big mistakes. The second is that upper level administration and faculty should already know a great deal about technology. Third, the computer people should already know a great deal about their institution and about higher education in general. Fourth, the upper level should have internalized enough of the issues surrounding technology in higher education to be able to make informed judgements. They should not be looking to rely on an expert or a "high priest" to do the decision making for them, this being an anathema to the very nature of collegiality. Fifth, the school should have a governance structure in place to listen to input from all over the campus. Sixth, the institution should have already made significant inroads into end-user computing and distributed processing. And, finally, the school should have an overall strategic plan in place, from which the long-range computing plan can be drawn.

Pitfalls to be avoided in attempting to establish such a position were described thus:

> The timing ... is critical. Having a czar come on campus too early means risking that there won't be the support structure in place for the person to succeed. It could be that there will be too much or too little power placed in the position. Worst of all, the expectations for the position may be so entirely unrealistic that they will lead to nothing but a great deal of frustration and disappointment.

Fleit's closing summary seemed to support other authors' suggestions that the chief information officer emphasize collaboration rather than line management functions.

> What we need ... is someone who can help expand our horizons and our opportunities. We need someone who will be an enabler. And while we want to have someone to help us take the very best advantage of technological innovations, it is critical that we provide the right environment for success.

In a May 1988 article, Robinson reinforced much of what Fleit had written when he proposed that

> ... the view of a computer "czar," wielding extensive powers over institutional computing and information systems, is changing. While strong management is more than ever required to accomplish and expedite the goals and tasks laid out, and extensive skill is essential in such areas as technical evaluation, negotiation, contracting, and performance measurement, ... the "czar's" role is altering to one of support, leadership, and motivation. The role should be one of service, with a responsibility to establish policy through consensus. Real leadership skills are essential.

Finally, in their article about cooperation and leadership in information technology management on campus (Summer 1989), Ryland and Smallen summarized the need to change our technology-based approach to reflect the evolution of information technology on our campuses. They emphasized significant "forces for change":

> We need to confirm the potential for enhancing national competitiveness suggested by the use of information technology in the education process, both in the classroom and in the provision of information to facilitate decision-making in the business of institutional management.

Recognizing that "harnessing the resources of each institution in the most effective manner will ... require strong campus leadership, and cooperation among the components of information technology centers," they proposed an action plan including several critical points:

> Whatever the management structure, *someone* must provide campus-wide leadership and set the strategic direction for the use of information technology in the context of institutional mission and direction. The most critical information technology resource is staff expertise and it *is* more cost-effective to share it broadly. ...

"We need to confirm the potential for enhancing national competitiveness suggested by the use of information technology in the education process, both in the classroom and in the provision of information to facilitate decision-making in the business of institutional management."

> Our profession is at a critical junction. The roles of our computing services organizations are changing. The end-user/distributed computing revolution is leading us to an environment in which information technology will be put to use primarily by the university professionals who know their own jobs best. The roles of information technology professionals will increasingly become those of planners and consultants, ensuring access to and connectivity between information resources. Fulfilling these roles will require a broad perspective, one of the generalist who understands the needs of all campus constituencies.

We face many challenges and opportunities as professionals in information technology organizations in higher education. In the visionary article based on his CAUSE90 keynote address published in the Spring 1991 *CAUSE/EFFECT*, Heterick offered an "information triad" organizational paradigm to carry us into the future, a fitting closing for the discussion in this chapter:

> We have witnessed the rise and fall of the "computer czar." The latest management paradigm appears to be the Chief Information Officer. Some wag once remarked

that "if Machiavelli were alive today the Prince would be a CIO." I would hazard the heretical notion that the CIO position may not be well suited for higher education and may prove as ephemeral as the "computer czar." ... There are a number of campus service organizations that have in common the storage, organization, and delivery of information. Among these I would include the communications organization, the computing center, the library, printing and reprographics, learning technology, and even the campus mail. Joint planning among these organizations not only makes sense, but is a necessity if we plan to leverage information technology.

Herein lies an opportunity and a choice. The opportunity is to bring these activities together under a common focal point. If we do so, we quickly realize that we have gathered together 10 to 20 percent of the institutional budget. On many campuses, this grouping will be larger than any one of the institutional colleges. The choice will be whether to institutionalize another vice presidency and to develop these services internally, or whether to see this as a fundamental part of the institutional planning effort and "outsource" all, or most, of these services. By "outsource" I don't necessarily mean a commercial alternative, although I wouldn't reject out-of-hand that possibility. Perhaps more likely would be the rise of not-for-profit service providers to the educational community.

We have an interesting set of opportunities in a period of economic stress. Conventional wisdom might suggest that we retrench, protect our sacred cows, and wait for better times. A bolder strategy would be to seize this opportunity to reengineer our institutions (at least the information technology infrastructure part of them) not just to cope with economic stress, but to truly prepare our institutions to operate in the "information age."

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"... successful computing is a partnership between the central computing support organization and the client department."
Sanders, Spring 1991

4
Personnel and Operational Management Issues

by Albert L. LeDuc

A great many articles that have appeared in *CAUSE/EFFECT* over the past decade have been concerned with either the large management issues confronting centralized computing services or with the more immediate personnel issues confronting everyone. At times it seems as if the importance of those broad issues overpowers topics related to operational concerns. While we all may be intrigued by the latest applications of technology, an equally interesting endeavor is how organizations and personnel move together toward common goals.

Key topical areas that authors have dealt with in *CAUSE/EFFECT* include:

- Communication and cooperation
- Personnel issues (recruitment, motivation, productivity, development, evaluation)
- Management roles, relationships, and styles
- Entrepreneurship and marketing

Both the quality and importance of these topics become clear in any review of the articles published in the first dozen-plus years of *CAUSE/EFFECT*. Even more telling is the fact that in the ten years that articles have been considered for the *CAUSE/EFFECT* Contributor of the Year Award, four of the award winners have dealt with personnel/operational issues—a significant representation in this area.

Communication and Cooperation

The problems and opportunities surrounding communication have been central to many *CAUSE/EFFECT* articles, even those ostensibly about other subjects. Explicit advice about written communication was given by Mullins (September 1983) in an award-winning article in which she noted that writing as good communication has more to do with thinking than with writing:

> Effective communication depends on several ingredients. Of these, an appropriate readability level and thorough analysis of audience merit special attention. Without that attention, even the most carefully researched work will not achieve the impact it could have had.

Mullins' article explained readability levels and audience analysis ("write at least two grade levels lower than your least educated reader has completed") and provided many useful tips for good communication ("when people pick up something we wrote, we have five to seven seconds to grab their interest").

When communicating with non-technologists, it is especially important to avoid the "jargon" of our profession. In an article about marketing the computer plan, Hawkins (November 1987) advocated that the plan be written in the simplest, easiest-to-understand manner possible:

> Technological jargon and buzz words may create barriers, detracting from the efficiency of communication. This technological jargon is sometimes perceived as a form of mysticism, or a deliberate attempt to keep people from understanding.

Ellzey (March 1978) noted that successful communication is a pre-condition to successful systems: "Communication is a neglected child, deserving constant attention in order to realize its full benefit." His article set up a communication structure for a systems development activity at a hypothetical university. He was trying to avoid the communication problems inherent in classic pass-it-around situations, best understood by most people from the parlor game of "gossip." Ellzey established that "interaction is the key to successful communication."

Penrod and Wasileski (November 1980) quoted from Steiner and Miner's *Management Policy:*

Communications may be considered at four different levels of analysis. One is intrapersonal, which relates to how an individual takes in, processes, and produces communications. A second is interpersonal, which deals with interactions between individuals and groups. Third is the flow of communications in channels in organizations, both formally and informally. Fourth are systems of data flow, including computer applications. The more efficient these systems are, the better will be implementation of policies and strategies.

Establishing organizational structures to facilitate better communication with user departments has been a subtheme of several *CAUSE/EFFECT* articles. Sanders' Spring 1991 article described the Departmental Computing Coordinators program at Loyola University Chicago, an idea that could very well be a model for communication and coordination. Essentially, Loyola's arrangement calls for the reassignment of some areas of end-user computing responsibility to users, who are sometimes LAN managers and sometimes secretaries. Although the program was intended to leverage both computer and staff resources, its value in enhancing cooperation was also recognized:

> A key assumption of the program is that successful computing is a partnership between the central computing support organization and the client department. ... The Departmental Computing Coordinator program has been quite successful in meeting the primary objective of improving communications between IT and its clients.

"Employees care because they have a voice; management reaches better decisions because employees have that voice—and care."

The University of Michigan also created a vehicle for ensuring good communication between central computing and departmental faculty and staff. Cross, Elser, and Tuer (Winter 1989) described this mechanism—called the Departmental Planning Team—as the solution to the challenge of providing "information technology planning support for the University's schools and colleges. Without such assistance across the full range of computing issues, there was no way to ensure that the 'information technology enterprise' would be coherent, integrated, and efficient within the University's highly decentralized environment."

The need for communication and cooperation is why people constantly devise new modes for systems analysis, why people debate the appropriateness of the "user" designation, and why people hem and haw about the political consequences of organizational change. Cooperation is the major reason for the concern that people express about communication and many other personnel issues. How do people work together effectively? As with many items that deal with personal relations, our comfort level for cooperation is only emphasized by the foundational importance it has. Although only one *CAUSE/EFFECT* article dealt specifically with the need for cooperation on campus (Ryland and Smallen, Summer 1989), it is fundamental to much of what we actually do as managers, and thus it is not surprising that it has been an underlying theme in many articles published in *CAUSE/EFFECT* over the years.

Personnel Issues

> Managers within the computing services environment face an unusual array of pressures: technological change affects them much more than other managers; critical projects and deadlines are the norm in their areas; and in most cases severe cost constraints prevail .... Hidden amid these pressing problems are a complex of underemphasized activities that form the real locus of concern for the astute manager. (LeDuc, May 1985)

That real locus of concern is personnel issues. Outside consultants are usually brought into the computing services area to solve a specific and defined problem for which assignment of internal resources is impractical. However, one of the hidden agendas that occasionally crops up is that using outside consultants may allow the organization to avoid personnel management issues. In a March 1979 article still useful today for its insight, Dickens noted that, even with the use of outside consultants, internal personnel management cannot be ignored—"successful projects seldom have as much as half of their full cost reflected in externally acquired resources"—so attention to internal personnel resources is still paramount.

What pressing personnel issues have managers occupied themselves with, at least as seen between the covers of *CAUSE/EFFECT*? First of all, there is *recruitment*, which according to LeDuc (July 1982) is a "key part of personnel management activity ... [that] takes a lot of effort." But there are many reasons why it is important: "There is no substitute for attention to personnel activity. People cause systems and activities to prosper." The point of this article was that recruitment is the first step in ensuring that the correct people can be brought to work effectively on the correct problems. That can be, in some ways, a remarkable epiphany for new managers in the information technology area, who somehow expect people problems to disappear under the cover of logic and technique.

Once the right people have been hired, what happens next? A May 1980 LeDuc article explained external and internal *motivation*, coming down on the side of the importance of internal motivation. We should not be seeking to determine motivation in order to "satisfy" employees; rather, "the employee must be responsible enough to want to improve performance." The manager "needs to establish and encourage an atmosphere that values achievement and challenge." A specific and valid motivational technique is the structured retreat. Wixson (Summer 1989) detailed how organizational enthusiasm can be gained through a manage-

ment-sponsored retreat, which propagates a positive philosophy: "... a true win-win scenario. Employees care because they have a voice; management reaches better decisions because employees have that voice—and care."

The related issues of *productivity* also should be occupying the manager's time. An article by Davis and Smith (March 1984) noted software tools, hardware tools, internal motivation, communication, and training as foundations for productivity. The authors also proposed closer cooperation with the computer science area to benefit from research: "All the improved tools and methods, staff education, and staff motivation that lead to more productivity during analysis, design, and implementation also produce a more maintainable product." These authors also cited some specific guidelines for enhancing productivity that are very prescient, for example: the banning of assembler language code, the use of application software packages, the use of a self-contained query language, the provision of direct access to equipment by users, and the responsibility of effective application program documentation. An excellent vehicle for enhancing productivity espoused by McDonald and West (September 1980) was the elimination of printouts for programmers. Though those authors considered this practice at Brigham Young University "heresy" back then, today it is a matter that is virtually doctrine.

A key article by Collier (January 1982) tied together attitudinal motivation and development as pre-requisites to productivity. The author noted that "unfavorable attitudes will block job involvement and productivity." The manager is not a mere passive onlooker: "The employee-centered, supportive, participative, satisfying managerial environment is one in which productivity flourishes."

Personnel development, that is to say the process of improving staff capability, is also of prime importance to people considering successful and necessary management strategies. Clearly, this is becoming an ever-more-critical issue today. Re-training (or reengineering, as some people put it) the workforce in computing is at the top of the agenda, as the volatility of the field virtually dictates continuous skill development. But this is not a new issue. In his remarkably comprehensive article, Dickens (already cited) stated, "Perhaps the greatest single challenge computing managers face is the retention and continuing development of a skilled technical staff." He emphasized that a key management strategy has to be keeping your own personnel abreast of this ever-changing field.

LeDuc's November 1983 article devoted to staff development alleged:

> No organization today can afford a large proportion of people whose skills are not going to expand. The healthy organization always has numerous people who want to work toward more responsibility, who want to develop their careers, or who want to upgrade their skills.

Clearly, the manager's duty is to promote that healthy environment:

> Personnel development is a leadership role ... . In a technological field, the person who does not develop himself or herself is actually going backwards. The pace of change dictates that the organization encourage individual development in order to avoid organizational obsolescence.

Personnel *evaluation* forms another of those sticky issues requiring a deft touch and great care. Expert advice was given by Turner (March 1980) who outlined a specific appraisal instrument, intending to foster "communication at multiple levels in the organization, while providing feedback and reinforcement to the employee being evaluated." The emphasis in that instrument and process was, quite correctly, on productive communication. An author excessively quoted in this chapter stressed evaluation as a continuous process, not just limited to the periodic appraisal (LeDuc, May 1985): "Every time the manager muses about personnel, some form of evaluation should take place."

"In a technological field, the person who does not develop himself or herself is actually going backwards."

Management Roles, Relationships, and Styles

Roles played by information technology professionals have formed an interesting series of discussions within the pages of *CAUSE/EFFECT*. The May 1988 issue contained two articles of abiding interest in this regard. May's article in that issue had as its theme the notion that the "data processing manager" role is evolving into a coordinator role, a term that May noted is not assertive enough even if that is a properly-defined role. Observing that data processing management is not concerned with either "data," "management," or "processing," May noted that the real role of IT is very much related to the goal of increasing productivity of end users. It is fascinating to realize that this theme is just now emerging as a discussion item in the general literature of the computing business. As May quite accurately pointed out, "Access, tools and solutions, and support (training, consulting, information networks) become increasing concerns for the DP organization."

Robinson's article, in the same issue, called for a true leadership role for information technology management. The role of the "czar," a jocular term popular at the time, or rather that of the CIO (Chief Information Officer), was noted as needing to include empowerment "to identify and implement improvements in the critical mainstream functionality" of the institution.[1]

[1] See Blackmun's extensive discussion of the CIO concept and role in Chapter 3, pp. 23-26.

An interesting relationship undergoing continuous evaluation is that of computing expert to user. Certainly that relationship should be expected to undergo change as the user has become ever more computer literate. Not as often cited is the other evident trend: the computer expert has come increasingly closer to trying to understand user concerns. Warford outlined that situation (May 1982), postulating a systems analyst role that was termed a "Decision Support Coordinator" whose chief distinction was that it was "client oriented" rather than "project oriented."

"... service must be foremost in the minds of present-day directors ... if their shops are going to grow with technology instead of being swallowed by it."

Clem and Olson (September 1987) explored another affinity when they described a third-party relationship of computer services to a bystander, but critical, user office—auditing. That relationship was described as a "partnership," building user credibility in a system being developed. The auditor noted: "I have been used as an independent sounding board to whom the project team and users alike can express their hopes and frustrations."

The efforts of the computing organization and executive management to understand one another is another relationship that has been well explored in *CAUSE/EFFECT*. It is a mistake to characterize this struggle as paranoia on the part of information technology personnel. It is equally incorrect to attribute this missed dialogue to preoccupation with technical detail. The truth is more complex. A number of articles published in *CAUSE/EFFECT* have an underlying concern that the institution lacks an understanding of what goes on in Information Systems.

Berry initiated this theme in September 1978 by titling systems development a "logical approach in an illogical environment." Calling for a "sensitivity to institutional politics" in order to achieve success, most of his article dealt with management's insensitivity to project task reality. Ellzey's article, previously cited, had much the same theme, noting that the cultural differences between computing people and management are significant, because "the rules for decision-making in data processing are generally more restrictive and complex than those of management."

LeDuc's Summer 1989 article noted that systems development is, just naturally, an alien area to executive management, but that this natural phenomenon is "a consequence of a world-view dramatically different from that seen from the inside" of a computing services organization. In a September 1986 article that won the 1986 *CAUSE/EFFECT* Contributor of the Year Award, this same author grumbled about strategic planning as an executive solve-all that actually causes more problems than it solves: "Top management's enthusiasm for strategic planning is only matched by operational management's distaste for it." That distaste is produced by a corresponding real need for operational planning and action.

Berry (May 1983) was critical of the information technology professional whose attitude toward users was that of "technical wizard" who protects his machine from the onslaught of users. He argued instead for a very different style, i.e., a service mentality that emulates the customer-vendor relationship. Perhaps, he noted, early computer center directors became so caught up in the technology that they failed to provide service, but

> ... service must be foremost in the minds of present-day directors ... if their shops are going to grow with technology instead of being swallowed by it.

While making a case for major service commitments in the areas of operational support, technical expertise, and system development, he also recognized the inherent difficulty of gaining additional management support when there was a poor track record for the kind of support management actually needed.

Berry advocated small incremental changes and high visibility projects to build success, believing that eventually top management would be more willing to allocate resources for improvements to the foundation of the shop. He concluded, "With this level of commitment, and with a service orientation toward users, 'Computer Services' will never again be used as an example of an oxymoron, a contradiction in terms."

It would seem that the question of management style would be fertile grounds for research and bemusement. Ahrens and Bryson (January 1983) characterized and classified successful management styles in MIS. By amusingly and thoroughly discussing the "flamboyant conceptualizer," the "benign underachiever," the "tyrant," the "efficiency expert," and the "fast tracker," they depicted all of the most familiar stylistic failures. They noted in the end that "the effective MIS executive in higher education is probably more administrator than manager, thus more people-centered than job-centered."

Certainly there are continuing debates about whether this is now even more true, in the era of the CIO, but there will be little debate about this truism:

> Only when the personal characteristics of an MIS administrator support and enhance an atmosphere of trust and cooperation among all levels of administration is there any likelihood that the MIS effort will ever be termed successful.

As for skills, very little is in the literature to help the manager determine what skills he or she needs to have or develop to be the successful manager of an information technology enterprise in higher education. Parisian, in an exceptional November 1986 article, reported some preliminary research on just that issue, providing a unique view of the necessary skills (roles and styles, as well) for managers in administrative information systems. Curiously, her study

showed significant differences between directors of computing services in industry and in higher education. The former were found to be less self-critical and seemed to rate technical expertise as being more important in their jobs. While the study was very limited, it did point the way toward speculation about the perceived importance of skills in this class of manager.

How can we project roles and skills into the future? One author, in 1978, predicted that "the job category programmer will disappear by 1983." Given that unfulfilled prophecy, perhaps we had best not try to make predictions!

Entrepreneurship and Marketing

One of the most interesting themes that crops up in some *CAUSE/EFFECT* articles is that of entrepreneurship. The topic may play a bit strangely to those areas accustomed to trying to be quiet and competent, but several authors noted success stories based on a very activist view of promoting organizational growth. Bushnell and Heller (Fall 1989), for example, described the framework of MIT's competitive application development organization. With the advent of powerful computers and alternative sources of computing resources, the in-house service organization must become like a business:

> Concepts such as market research, marketing, service level agreements, cost-recovery strategies, and customer service, which in the past were all but unknown ... become key considerations in the competitive environment.

Munn (January 1980) launched a plea to consider marketing the need for information systems at the University of Michigan to a wide audience in order to properly communicate the utility of the IS organization:

> Marketing is ... the development of an attitude within an organization that the purpose of the organization, unit, or department is to understand the customer's needs and to design and offer appropriate services and products to satisfy them.

Note that Munn's analysis is strongly dependent on an internal understanding of mission as well as an external and compatible understanding—both of which are communication considerations.

Recognition of the need for generating support for information systems was also addressed by Davenport (Spring 1990). His article focused on the need to convey the importance of IS to academic staff, and he suggested the creation of an interface between the IS group and the academic leadership based on emphasizing the ability of the IS group to support the academic mission of the institution by bringing their special knowledge and skills to bear. He concluded that "while technical skills are as important as ever, they need to be supplemented with the ability to explain to professors, chairs, and deans what is being done and why it is important."

May's Spring 1989 piece identified chaos as the characteristic situation on campus, taking a cue from Tom Peters, whose *Thriving on Chaos* dealt with the marketplace reality of chaos. According to May, change is endemic, a frightening reality that causes difficulty in marketing: "Formalized methods of reaching our customers must be continuously reassessed for effectiveness. The bottom line is that all communications channels should educate." May offered a very sound way of coping with this uncertainty: "The best marketing strategy we can adopt is concern for our user constituencies and the long range solutions to their problems."

"Formalized methods of reaching our customers must be continuously reassessed for effectiveness. The bottom line is that all communications channels should educate."

A Look to the Future

There is much that needs to be written in future *CAUSE/EFFECT* articles to continue the tradition of this magazine as a vehicle for professional publication and experience sharing. What are some of the areas we as a profession need to address?

There can never be too much said about communication. Research and further articles are needed about the success of different modalities of communication. How does a manager best get across a viewpoint or a strategy to his or her subordinates, peers, supervisors? For that matter, how does an astute manager negotiate? Similarly, a related area that needs to be addressed is the value of newsletter publication and other means of communication between central computing services and academic and administrative departments. Still another is the appropriateness of the medium for messages—when is e-mail more appropriate than the telephone, computer conferencing better than meeting in person or written communications? How do organizations differ in their need for and use of such communication media as voice mail?

With personnel development an important part of managing information technology, future articles need to deal with personal enhancement and professional development, especially exploration of the necessary skills for an information technology manager in today's changing environment. While publication of Smallen's "master reading list" (Spring 1991) was a first step toward specific skills augmentation, and the establishment of the CAUSE Summer Management Institute, offering the opportunity for immersion in personnel and management concepts, was another, we need to encourage more *CAUSE/EFFECT* publication in this area. Stress management and leadership skills are also very popular topics at the Institute that need further elaboration in *CAUSE/EFFECT*. And, finally, research needs to be undertaken and reported with respect to where information management professionals of the future will come from: is there a career track for our profession?

Let's hope that a review of *CAUSE/EFFECT* articles a decade from now will demonstrate that the magazine has continued to cover personnel and operational management issues to ensure that today's developing professionals will be tomorrow's information technology leaders.

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"If we are to achieve the goal of integrating computing into the fabric of teaching, learning, and research, computers dedicated to academic purposes must be relatively open and easy, even attractive, to use."
Webster, Winter 1989

5

User Computing and Information Access

by Lore A. Balkan, Patricia S. Ernest, and Gerald W. McLaughlin

In their award-winning *CAUSE/EFFECT* article, Blackmun, Hunter, and Parker (Fall 1988) described the development of end-user computing, from the 1960s through the mid-1980s, for three platforms of computing: mainframe, minicomputer, and microcomputer. These authors aptly compared the development of end-user computing to the development of the automobile in the first half of the 20th century—initial owners had only limited support available and were forced to be very knowledgeable about the technology and its application. Just as the automobile's evolution allowed owners to move away from metropolitan areas and prompted interstate highway systems, the expansion of microcomputers created distributed environments with networked infrastructures, with significant implications for user support activity.

Academic libraries, especially at major research universities, were among early users of computing, initially realizing the benefits of automating catalogs and later expanding their use of technology to include networking and development of standards for electronic data sharing. The ever increasing interconnectivity and resulting increased access to library information, along with a similar demand for and ability to access administrative data on campus, prompted attention to security and access issues and, consequently, to data use concerns of ownership, integrity, and ease of use.

This chapter examines several areas of management involvement arising from user computing, as evidenced in *CAUSE/EFFECT* articles published over the past decade: user support, library automation and access, administrative data access and security, and data standards and coordination.

User Support

Blackmun, Hunter, and Parker defined end-user computing support as "providing the information and assistance which enables people to use computers and other information technologies as effective tools to accomplish work." In the early days of campus computing, support for end users was provided by a central organization responsible for both mainframe and minicomputer environments.

Although most user computing discussions focus primarily on the microcomputer—as will this one—it is important to remember that many campuses had begun strong support programs for mainframe terminal usage by the early 80s, before the widespread use of micros. Bennett wrote about such a program at Stanford University (May 1981 and September 1983), called the "Terminals for Managers" program. In August of 1980, this program placed terminals on the desks of more than 100 of Stanford's principal officers, including the president and five vice presidents. Three years later, Bennett reported that nearly 1,300 personnel—faculty and administrators—were routinely using their terminals to "enhance communications, provide computational support, and support text processing." He concluded that the program had been extremely successful:

> The users of the system have come a long way in understanding information systems and information technology. They like the facilities and have integrated them into their daily work environments. It is the users who are telling us how they are able to increase their own effectiveness and it is the users who are, in the last analysis, the final judges of such facilities.

Within a few short years, IBM's entry into the personal computer market had revolutionized the issues of user support, but the bottom line remained the same: increasing effectiveness. Sholtys (July 1986) recognized that maximum benefits of this new technology could be attained only if managers both understood applications and personally used the micros to "support their analytical and decision-making processes." This meant overcoming managerial resistance to personal use of computers due to lack of time, absence of keyboarding skills, computer phobia, and concern about exposing technological ignorance to subordinates. According to Sholtys, managers perceive themselves as "achieving

their goals through coordinating and directing the work of other people, not by using machines." Her article described a workshop at Northern Kentucky University, designed to address managerial needs, that demonstrated that learning about computers can expand a manager's skill set.

Student use of microcomputers on campus was also increasing dramatically, in some cases as a result of institutional requirements for purchase and use, but more often as a personal choice to improve productivity. McLaughlin, Muffo, Mueller, and Sack (July 1987) reported results of a study conducted in 1985-1986 at Virginia Polytechnic Institute and State University to assess student computer usage. They identified several areas that need attention when formulating student microcomputer policies and programs: (a) student computer experience prior to college attendance; (b) perceived importance of computer skills in future careers; (c) clientele to be served; (d) curricular provisions (service courses, tutoring sessions); and (e) equipment provisions (purchase, use, access, software, repair). Data indicated that certain hardware, software, and support needs of students should be provided by the institution. This study not only identified direct and obvious implications for proposed policies, but also revealed latent or implicit needs that might otherwise have gone unrecognized. Service courses, computer labs with printing and electronic communication facilities, software, and repair services are needs which policy makers and administrators must address.

"The benefits can be huge, as long as planned distribution of processing, not total decentralization, is the end product."

Muffo and Conner (March 1988) noted the profound effect computerization was having on the way students, faculty, and administrators were interacting with each other. Their article described some of the "unexpected changes in human interactions precipitated by the introduction of easily accessible computing in the academic workplace." Among the unexpected outcomes they noted were changing alliances and behavior; changing communications; changing skills, training, and standards; changing student-faculty interactions; and changing roles of programmers and users.

The proliferation of micros on campus caused other types of service issues to arise. The benefits of the microcomputer were obvious, but increasing questions surfaced for users: which hardware, which software, what configuration? Also, learning the basics of good computing is time consuming, detracting from regular responsibilities. Finally, issues about campus-wide compatibility, database administration, and data networking became relevant for both central computing personnel and end users.

Smallen (May 1988) addressed many of these issues in an article about managing administrative microcomputing. The strategies he presented included standardizing hardware and software configurations used in offices, simplifying the workstation operating environment, avoiding data redundancy, and avoiding programming applications on personal workstations. In addition to reporting some successes, he also quite candidly reported what he termed some "moderate disasters" and shared eleven lessons learned, concluding: "It is inevitable that microcomputers will find their way into administrative offices .... What is important is the way in which their use is managed by those responsible for providing administrative computing services."

Fleit and Whiteside (November 1985) described the University of Hartford's cooperative, campus-wide approach of working toward the goal of independent, end-user computing: "The benefits can be huge, as long as planned distribution of processing, not total decentralization, is the end product." They offered seven guidelines for managing microcomputers and distributed data processing:

1. A set of standards for hardware should be developed, regardless of who actually does the purchasing, with attention to campus-wide compatibility and ease of use. The standards could take the form of a preferred configurations list.
2. Standards for software and software development should be established, with consideration to maintenance and appropriate documentation.
3. Security and data management should be monitored by some central organization to maintain controlled access to sensitive data.
4. End-user computing processes should be well documented to provide all users with information such as when and how to back up disks, how to keep local data secure, and how to obtain hardware service.
5. There should be a document of understanding between the central facility service organization and end users covering such policies as system usage, equipment ownership, and hardware charges.
6. There should be an institutionally-agreed-upon set of guidelines governing which applications can and should be implemented on a microcomputer
7. There must be a consensus of the control location for computing policies.

These authors emphasized an emerging philosophy on the part of the central facility: "a new emphasis on assistance-to-the-user rather than doing-for-the-user." This approach signaled a partnership between the central computer facility and end users, allowing for necessary experimentation and flexibility while also maintaining structure and cost effectiveness.

Planning in such an environment also became a crucial issue for users and managers. Users expected the same level of support for personal computers that they had received while using the mainframes, but managers had little experience with planning for the necessary financial and person-

nel adjustments. Budget realignment was necessary due to a change of ownership: mainframe configurations belonged to the institution, but the microcomputer systems were owned by the departments. At the University of Kansas, the Office of Institutional Research and Planning and the Office of Information Systems found that many users had developed their own informal networks of support. According to Paschke, Haren, and Nicholas (November 1984), a more formal "integration of solutions and services under a loosely-defined 'umbrella organization' such as an Information Center could greatly enhance user productivity and advance overall computing efficiency at the institution."

A similar conclusion had been reached at the Cooperative Computer Center in Illinois, in response to a recognized inability to provide required user support. According to Lewandowski (January 1984), examination of the service requests backlog at the Center revealed two distinct categories: enhancements to existing systems and requests for data extraction. Since users were working with their own databases, why not allow them to determine their own needs, and extract the data themselves? This evaluation prompted the establishment of an information center to increase user self-sufficiency, thus reducing the need for programming from the central computing organization.

Establishing an information center was also a solution at McGill University in Quebec. According to Bates and Leclerc (November 1985), the management systems unit realized "a need to do something about micros on campus before chaos set in." A microcomputer information center was established to support administrative users of micros and academic users of administrative packages. After two years of operation, they concluded: (a) microcomputer support is vital for administration; (b) user needs change very quickly; (c) a formal information center is the best mode to meet needs, recognizing it is a major resource and time commitment; (d) staff must be "user friendly"; (e) financial support can be a chargeback system; and (f) "Super Users," very proficient in various applications, develop naturally and can be utilized as experts.

The Revolution in the Library

While academic and administrative use of microcomputers was growing throughout campus, another revolution which had started in the previous decade was gaining momentum in the campus library. An early *CAUSE/EFFECT* article by Pierce and Crockett (January 1979) noted three major trends in library automation activities as the 70s drew to a close:

1. use of large dedicated computers serving national library data needs through modified star networks;
2. almost universal adoption of online processing; and
3. division of automation activities into closed turnkey systems—such as the commercially developed minicomputer circulation systems—and "open" systems that are amenable to change as required.

The authors discussed cataloging and catalogs, online literature searching, and circulation systems in terms of the need to have online capability rather than batch processing. They noted that while the culture of the librarian was different from that of the systems developer, finding common grounds for cooperation was possible and profitable and, as evidence of that proposition, described the development and implementation at Virginia Tech of a "circulation and finding system" as a model for library automation.

"With increasing sophistication of users on campus, demands will escalate for the integration of network access to external databases with local [online public access catalogs] and networks."

Within two years, Chachra (November 1981), also of Virginia Tech, was writing about the impact of local library systems on national library networking:

> The rapid growth of local systems along with escalating costs for using national networks [such as OCLC and RLIN][1] is precipitating a new crisis. The national networks are fighting for survival and some are scrambling to cash in on the lucrative local systems market. It is exceedingly obvious that functions like circulation control, replacement of the card catalog, serials check-in, and even acquisitions are better done locally. Shared cataloging and interlibrary loans, however, require some form of networking. ... I believe that a network like OCLC represents an important national resource. Survival of national systems, or at least a national system, is very important to the general well-being of libraries. Long-held views on the role of national networks will have to be revised to accommodate the current realities.

As the decade came to a close, the impact of "globalizing a campus library" was raising even more political and technical questions. Woodsworth (Summer 1989) succinctly presented the many issues arising from the establishment of local and regional library consortia. These issues not only affected campus library policies, but also precipitated a multitude of difficult consortium decisions which Woodsworth enumerated. She concluded,

> With increasing sophistication of users on campus, demands will escalate for the integration of network access to external databases with local [online public access catalogs] and networks. In providing these services,

[1]When Chachra's article was published, OCLC was the acronym for the Ohio Center for Library Computing but today stands for Online Computer Library Center. OCLC is a membership organization of libraries, providing online access to a database of over 21 million bibliographic records that can identify over 350 million individual book locations. RLIN—Research Libraries Information Network—is a national network developed by the Research Library Group (RLG).

"... the future depends on our ability to address technical, political, and personnel issues both within and beyond institutions."

> campuses will have to define the extent of access that will be allowed by local and external users, along with all of the attendant cost and policy issues ... .

While much was being written about the ability of digital technologies to transform the library, in a Summer 1990 article Heterick focused on some of the potential inhibitors of this transformation and some of the steps that colleges and universities could take to overcome them. He proposed that libraries could:

- Implement policies that favor access over acquisition, and favor the electronic version of shareable material over multiple hard copies of the same material.
- Implement policies that favor high-density storage over expansion of current library facilities.
- Seriously consider the advantages of a union catalog for academic libraries in a defined region.
- Encourage appropriate government officials to investigate and help shape copyright law interpretations.
- Support the efforts of the Coalition for Networked Information to bring an increased richness of digitally encoded material onto our academic networks, and support the efforts of the National Telecommunications Task Force in encouraging the creation and federal funding of the National Research and Education Network.[2]

The most indicative sign regarding the future is the movement toward partnerships between computing and libraries that Rosser and Penrod outlined (Summer 1990). As early as 1979, Pierce and Crockett had acknowledged differences in these two cultures, but argued that there were many benefits from cooperation. While their emphasis was on cooperative systems development, Rosser and Penrod emphasized the importance of joint planning efforts, noting that information resource management and library professionals need to create linkages between their planning strategies to create a new culture that takes advantage of the acquired wisdom of both. This was a call to leverage technology—not just to use computers to automate existing processes.

Most recently, Peters (Summer 1991) proposed that the future depends on our ability to address technical, political, and personnel issues both within and beyond institutions. An openness to change and a willingness to share knowledge and negotiate will be required to establish more effective paradigms for pricing, protection, regulation, distribution, and use of networked information.

Administrative Access and Security Issues

A broader base of users, an increasingly networked environment, and numerous opportunities to share information have brought about the need to protect information resources from unauthorized access, especially in the administrative information systems environment. Thus we have found ourselves struggling with legal, technical, and ethical issues in an effort to balance the requirements for data access against the need for data security. On the surface it might appear that the area of computer security has been largely overlooked in *CAUSE/EFFECT*. In reality, however, security and access issues wind through nearly every user computing discussion, from the technology discourse on microcomputing to more political and philosophical debates on data planning and policy. In the previously cited article by Fleit and Whiteside, for example, five of the seven guidelines for managing micros and distributed processing related to security and/or access.

In a July 1983 Current Issues article, Doty forewarned: "Users will be reluctant to wrap their new friendly computer systems in a layer of bureaucracy, particularly if there have been no recent computer disasters. But ease-of-use is easily turned into ease-of-abuse." She then iterated an awareness that has moved from mere consciousness to the basis of action plans nearly a decade later: "A computer is not just another piece of office equipment, like a copier; it is a repository for vital information that must be protected."

A prime mover for security and access control has been concern about preserving the quality of data. Blair (May 1983) pointed out: "The potential damage from lack of information quality control occurs on two fronts—on the workings of internal management and on the information sharing dialogue between the organization and its publics."

In fact, the need to ensure quality information in a distributed environment, to recognize "data as a University resource that will be managed accordingly," and to establish a data administration function that includes responsibility for "data control and data accountability" was recognized by Naginey in one of the first issues of *CAUSE/EFFECT* (May 1978). Both Naginey and, later, Balkan and Sheldon (Summer 1990) explored the "data custodian" concept, wherein such officers as the controller, the registrar, and the administrative services vice president were each identified as ultimately responsible for specific segments of institutional administrative information.

Authorization and electronic signature systems were developed to solve the security problems that accompanied distributed processing. Balkan-Vickers (November 1986) reported that at Virginia Tech "more sophisticated access controls were required in order to implement source-point data capture, value-added data handling, and destination-

[2] The Coalition for Networked Information was created by the Association of Research Libraries (ARL), CAUSE, and EDUCOM in the spring of 1990 to advance scholarship and intellectual productivity through networked information resources.

point document generation." By design, Virginia Tech's electronic signature system "distributed access control management to those managers who could answer decisively 'yes' or 'no' and be held accountable." Access profiles reflected responsibility at every level of the organization.

The awareness that data need to be protected has prompted a search for definitions of what needs protecting, who is the protector or "custodian," and how data access should be controlled. However, this approach has been tempered by the passionate call to respect the power of shared information. Naginey proposed that data are "part of the fabric of the institution," and ten years later Webster (Winter 1989) echoed that philosophy: "If we are to achieve the goal of integrating computing into the fabric of teaching, learning, and research, computers dedicated to academic purposes must be relatively open and easy, even attractive, to use."

Clearly colleges and universities continue to wrestle with very real legal liability threats related to security of information and privacy, and to protect against errors, omissions, and inaccuracies. Curran (Winter 1989) examined student privacy issues from a legal perspective, providing a history and interpretation of the 1974 Family Education Rights and Privacy Act (also known as the Buckley Amendment). Campuses also must deal with the key issue of permitting access to "sensitive" information based on "need to know."

In the Winter 1989 *CAUSE/EFFECT*, which focused on security, ethics, and privacy issues, Ryland described a report of the American Council on Education (ACE) cautioning that an institution could be held liable for damages "for failure to use reasonable care to avoid unforeseeable harm to others," i.e., failure to create a well thought out security system as an attempt to protect users. Policy, rules, and sometimes very sophisticated controls and audits have been implemented in response.

Ryland's article included excerpts from a report published by Cornell University where the infamous Internet "worm" of November 1988 originated:

> A community of scholars should not have to build walls as high as the sky to achieve a reasonable expectation of privacy, particularly when such walls will equally impede the free flow of information. Besides, attempting to build such walls is likely to be futile in a community of individuals possessed of the knowledge and skills required to scale the highest barriers. ... The university can only encourage reasonable behavior, it cannot guarantee that university policies and procedures will be followed.

Webster noted in a Viewpoint article in the same issue that while some of the security measures we have taken are necessary, they are not sufficient. Too often these measures unfortunately put "responsibility for good computer behavior squarely on the keepers of the system rather than on the individuals who use it." An example of putting responsibility, instead, on the user is Virginia Tech's "rule-of-thumb" for determining data sensitivity, described by Balkan-Vickers in a March 1984 Input department article: "If you are not the source of the data or the creator of the information, you probably do not have the right to distribute or report it to others without permission." The implication is that job training and employee evaluation must therefore include attention to the proper use and protection of information.

Webster made the point even stronger: "Focusing on specific, concrete language in rules and policy statements and building better locks prevents us from putting computing behavior into the larger context of social expectations." We need to look at abuse in a larger context by synthesizing ideas and action with other campus groups, classes, and projects involved with raising ethical consciousness. The resolve on the issue of security and access control seems to settle on the essence of our institutional mission and precisely what higher education sets out to do best: Preserve and provide quality information and educate on its use and application.

"Institutional policies are needed to guide the responsible use of data, especially in a decentralized operating environment."

Data Standards and Coordination

Could it be that colleges and universities have taken the lead in reaching Nolan's maturity stage with respect to understanding the power of information? As noted above, data quality has been an ongoing concern of many *CAUSE/EFFECT* authors. Information systems professionals at colleges and universities have wrestled directly with the quality issue of data integrity, both in theory and in practice. This concern escalated in the late 1970s when we realized that distributed processing and decentralized support for administrative computing made sense and that technological capability and a broader base of expertise was quickly returning information processing and management functions to the operational offices. McLaughlin, Teeter, Howard, and Schott (January 1987) aptly pointed out that the early "monarch" environment of the 1950s and 1960s, where information and data flow were tightly controlled, evolved to a "managerial" environment where information and data flow had become decentralized. They recognized that both positive and negative aspects regarding power of data exist in a distributed and decentralized environment, where data become more accessible and thus also more vulnerable, and concluded: "Institutional policies are needed to guide the responsible use of data, especially in a decentralized operating environment."

While the need has been for standards, the discussion has remained primarily on organizational strategies and policy. The very nature of automation requires standardized representation of data, and the assumption has too often

"Physical attributes of the data element have absolutely nothing to do with standards."

been that standards were already in place. Braniff (November 1978) realized this common misconception when he stated, "Physical attributes of the data element have absolutely nothing to do with standards." And while problems and inconsistencies surfaced as a result of using data from distributed systems, the capability, availability, and usability of sophisticated software began to uncover embarrassing problems of data integrity, particularly across multiple data sources. Finger-pointing did little to fix things and the typical campus response was to draft policy that would promote cooperation. Though both of these responses were understandable, neither one proved adequate. Braniff proposed a "catalog of definitions" concerned with "the properties which a given entity must possess to be rendered unique and distinguishable from other entities within the scope of the system." He suggested mapping "equivalents of usage," a concept now supported by relational and object oriented systems and their companion dictionaries or repositories.

The necessity of such a mapping, or standardization, was clarified when Blackmun, Hunter, and Parker noted that, given that most end users use data from a variety of sources, a formal structure for providing access is necessary. Steingraber (July 1983) noted, "The centralized control concept will be replaced by the concept of the coordinator and data manager responsible for the data integrity and security of the data. Users will access and share their data through established protocols."

From this premise and realization, considerable work has been done on classifying information and data management roles. McLaughlin, Teeter, Howard, and Schott proposed three classes of files that could be accessed by managers: "official" files, which are point-in-time census files; "dynamic" files with current transactional data to monitor critical activities; and "manager developed and owned" files created for special purposes. They suggested the necessity for a higher level of consistency, reliability, security, and accessibility, and the need for formation and adherence to policies from a "campus-wide perspective."

> Since campus-wide policies will be detrimental in individual situations ... it will be essential that a strong, but not necessarily large, centralized data management function be created to help develop and ensure compliance with such policies.

Their proposed central function of "data administration" required a participatory approach through involvement of a policy group composed of both central and distributed system management personnel as well as a user group around each major system area.

Balkan and Sheldon described a similar participatory approach successfully used at Virginia Tech to develop guidelines for administrative information resource management. These guidelines were drafted and approved by both formal and informal university groups and committees, and became policy in 1989. They clarified the roles of a "data custodian," who is ultimately responsible for information management, a "data steward," who takes on a routine caretaking role, and the "data user," who also takes on data management responsibilities upon gaining access to administrative information.

> The function of applying formal guidelines and tools to manage the university's information resource is termed "data administration" ... a role overseen by data custodians, but played by all participants.

Adherence to the guidelines implied standardization of data across administrative systems and called for continuous work in this area.

Howard, McLaughlin, and McLaughlin (Summer 1989) were concerned that "many operating databases have been created and maintained without concern for their use in decision-making or planning activities. Though data administration has been viewed as important, it seems to have taken second place to the exciting technical advances of computing and communications." They proposed that the usefulness of data from an institutional perspective must be attended to in terms of accessibility, comprehensiveness, and relevance: "It takes effort to move facts into increasingly more useable forms of data, information, and intelligence." This requires "an active data element dictionary coupled with a competent and pervasive centralized data administration function." These authors also identified the "need for developing a capable user community which shares the value of data as an institutional resource."

Perhaps what is most clear in this review of *CAUSE/EFFECT* discourse regarding data use and coordination is that the needs of decision-makers must be taken into consideration, that consistency across data sources must be maintained, that the meaning of data and information must be readily understood by all, and that ensuring data quality is a big job that must be shouldered in part by all who manage or use information. As Howard, McLaughlin, and McLaughlin concluded: "If we fail to turn our attention to the problems at hand, it is unlikely that technological developments will improve the quality or impact of information needed for control and strategic decisions."

Summary

The history of user computing and access to information has been one of rapid change. The networking and cooperation of libraries has given us a glimpse of both the user empowerment and the logistical challenges of the future. While external groups deal with societal information issues, internal processes need to deal with the ethics of information, balance security and access, and sustain the quality of our campus information resources. Professional managers of information technology must take an active role in leveraging the power to the user.

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"Strategies without information technology are hollow."
Nolan, Winter 1990

6
Strategic Planning and Information Technology: Beyond Missions and Machines

by Sue A. Hodges and Ronald L. Moore

Who would think that strategic planning and information technology would have much in common? In fact, they do share many common characteristics in higher education. First, both have only recently matured in colleges and universities over the course of the past fifteen years. Second, not only do both touch on all functions of the organization, but both are now requirements for any department to carry out its mission effectively. Without goals and objectives, an organization will accomplish its mission only by accident. Even if it has the appropriate technology, much of it will likely be wasted without a thoughtful plan to guide its application. Conversely, a college or university with a comprehensive strategic plan will still find implementation difficult without the technology to support academic and administrative goals.

On the other hand, strategic planning and information technology are very different, but in ways that complement each other. While the technology of today is dramatically different from ten years ago, the most successful strategic planning models have remained relatively stable. And, while those planning models have focused on people and processes, technology's primary emphasis has been hardware and software.

It was only a matter of time before information technology managers realized that strategic planning could bring some order to the rapid pace of change. At the same time, strategic planners saw the critical role that information technology needed to play in implementing institutional goals. And so both planners and information technology professionals on campuses across the nation began talking to one another.

That communication is evident throughout many articles that have appeared in *CAUSE/EFFECT* since its inception. This chapter chronicles the linkages of planning concepts to technology issues, first with a quick overview of strategic planning and information technology in higher education, next by discussing planning and technology's role in organizational transformation, and finally by identifying a set of axioms that are prevalent in key articles related to planning that have appeared in *CAUSE/EFFECT*.

Strategic Planning and Information Technology in Higher Education

When strategic planning was first introduced to higher education in the 1970s, information technology was already an emerging force on campus. Even the earliest articles in *CAUSE/EFFECT* portended the eventual role that planning would play in the area of information technology.

In a September 1979 article, Topping wrote:

> Strategic planning ... involves the development of long-range plans only after considering the external environment, internal capabilities, and database analysis of past and current performance and forecasts. ... Planning is a necessary function in all organizations; however, the need increases as turbulence in the environment intensifies. When uncertainty exists, organizations must plan for environmental contingencies to adapt successfully to change. With the current educational environment in such turmoil, strategic planning has become an important tool in higher education.

An article by Sherron (November 1984) outlined two basic goals of strategic planning: "The first is to allow the organization to select a preferred future course of action from a variety of alternatives that present themselves. The second reason is to establish the extent of the resource commitment

that is necessary to achieve a plan's goals and objectives."

Planning was a key component of the PME (Planning, Management, and Evaluation) System approach, a popular management concept in the late 1970s. In a November 1980 article about the use of PME at a small liberal arts college, Evancoe wrote,

> Planning can be defined as a continuous and cyclical process through which members of an institution reaffirm the mission and establish realistic goals and objectives which relate to and carry out the mission statement. A viable planning process is characterized by its:
>
> - *Ongoing nature.* It is cyclical and fed by new input and by results of the evaluation process.
> - *Realistic timetable.* It is synchronized with other institutional activities and it can be accomplished within the time provided.
> - *Comprehensiveness.* It encompasses *all* institutional units.
> - *Integrated approach.* It interrelates *all* institutional units.

Another planning and management concept that emerged in the late 70s, causing an even closer relationship to develop between strategic planning and information technology, was Information Resources Management. IRM theory proposed that information resources are as critical to an organization as its financial, personnel, and material resources, and thus need to be managed and strategically planned for. To maximize these information resources, joint planning efforts on campuses to integrate information resource functions were called for. According to West (September 1980), "The 1970s witnessed the emergence of the 'Age of Computing' in our society. Universities and colleges developed instruction, public service missions, and administrative operations. As our society approaches the 21st century, the whole arena of information technologies—word, image, graphics, data, and telecommunication processing—will be more integrated into our way of life. To stay at the forefront in higher education, the information resources ... should be planned and managed in an integrated fashion for the institution."

Penrod and Dolence (May 1987) described the adoption of a new IRM approach at the California State University/Los Angeles, whose primary purpose was to "foster the communication process of the institution; to provide planning and technical guidance in the integration of varied, new, and existing campus information technologies; and to provide leadership in the efficient and effective use of a vital university resource—information." Of special interest in that article was the authors' note that Dr. Robert Shirley had developed one of the most successful planning models for higher education, which CSU/LA had adopted for its IRM plan:

> The [Shirley] model ... called for analyses of strengths, weaknesses, and environmental trends to feed a matching process relating external opportunities and constraints to internal strengths and values. The matching provided the basis for development of an extended mission statement, the delineation of clientele, the development of goals and objectives, and the establishment of an appropriate program service mix. These parameters then formed the basis for guiding the development of individual unit plans.

Strategic planners across the country still respect and use the Shirley model. Its prevalence can be attributed not only to the logic of its basic components, but also to its astute consideration of organizational behavior during implementation.

Implementing the Shirley model may serve as a catalyst for changes in the organizational structure. When changing the structure of an organization, solid strategies are necessary to maximize financial, information, and human resources. When good strategic planning converges with the appropriate technology and is implemented by motivated, creative individuals, the process of organizational transformation begins.

As we pointed out earlier, these variables are interrelated and dependent. Separately, they are difficult to implement and waste already-limited resources; together, they synergistically fuel the transformation process.

"When [information] technologies are adopted, changes occur in the ways organizational members think, act, and relate to each other."

Organizational Transformation

Changes in technology usually have dramatic effects on an organization and on the relationships among people within it. New technology brings about new challenges and requires new ways of thinking to respond to these challenges.

In her article about planning for the electronic institution, Leslie (January 1981) proposed a "framework and derivative course of action to higher education institutions as they move through transition from an industrial to technological society." She based her article on Alvin Toffler's theory of three waves of change moving through society, from agricultural to industrial to technological, proposing that higher education has also been affected by these societal changes with the effect being most dramatic in the areas of information and technology.

In an article published in July of 1982, Kriegbaum described the characteristics of the future economy and its knowledge organizations:

> One reason [information] technologies will come to dominate not only our society, but specifically our colleges, is that they offer the opportunity to increase productivity and control costs in a people-intensive enterprise. The other important factor in their favor is they let us do things we could not otherwise attempt. When such technologies are adopted, changes occur in the ways organizational members think, act, and relate

"The fact of the matter is that although higher education has spent literally billions of dollars on technology in recent years, many institutions are still waiting for the revolution to happen."

to each other. The college must have an appropriate organizational structure that will enable it to realize maximum benefit from the application of these technologies, while maintaining a clear vision of a significant societal purpose for the institution.

Nearly ten years later, authors were still emphasizing the need for organizations to transform to survive in the Information Economy. Nolan (Winter 1990) offered several ideas that executives today need to embrace in order to successfully lead such organizational transformations:

- technology drives transformation
- new technology enables new ways to do work
- the functional hierarchy is obsolete and the network organization is evolving as the new form.

According to Nolan, American colleges and universities must transform:

> They need to add information technology to their strategic equations to formulate viable 1990s strategies. Then they need to internalize and incorporate the Information Economy management paradigm to achieve a higher level of performance and sophistication in educating the future knowledge worker labor supply. ... Strategies without information technology are hollow.

As Nolan pointed out, technology changes can be the driving force behind organizational transformation. They force us to look carefully at how we do things and create a vision of how we could do things better using the new technology, to rethink the way the organization works and what needs to be accomplished—a process called reengineering.

Penrod and Dolence (Summer 1991) reviewed much of the management literature relating to the reengineering concept and its applicability in higher education. They proposed that "leadership is the key issue in reengineering," and that information technology units must be among the first units in the institution to make such transformations. Significant in the list of what it will take for our campuses to be transformed is the need to "set forth a well articulated information strategy that is synergistic with institutional decision-making," a strategy that "requires the information technology plan to be integral to the institutional strategic plan."

Though many *CAUSE/EFFECT* authors have been strong advocates for the tremendous potential of information technology to transform higher education, one author has more than once pointed out, quite realistically, that that transformation has yet to take place. In an article that won the 1987 *CAUSE/EFFECT* Contributor of the Year Award, Fleit (May 1987) declared, "The fact of the matter is that although higher education has spent literally billions of dollars on technology in recent years, many institutions are still waiting for the revolution to happen." In a more recent Viewpoint article (Fall 1990), she made a similar plea: "We need to get beyond 'the big yawn' to a place where higher education computing is well-understood, well-appreciated, and most of all, fulfilling its promise to transform our colleges and universities in the most positive ways."

Newman (Spring 1990) also voiced some frustration at the failure to fully leverage information technology in higher education. His article described the growing disparity in the way IT is being used on campus, arguing that little or no progress has been made in using technology to transform the teaching/learning process: "The average university in this country, in terms of its use of information technology in teaching, is substantially behind the typical elementary and secondary school. ... This lack of progress is not because of technical limitations, but because of the organizational mode and the policies of the university. It is how we make the investment decisions and who makes them. It is the traditions and incentives of how we do things in the academic community."

What can we do to ensure that the revolution *does* take place? We are now beginning to emphasize the strategic value of information technology in accomplishing organizational missions. As the IRM concept took hold in higher education, we saw the emergence of the chief information officer (CIO) position on campus and reorganizations that have brought together academic and administrative computing, telecommunications, the library, and other information-related functions.[1] Perhaps the most important task for information resource planners in the higher education environment is the establishment of an information architecture. Networking technology has created unlimited opportunities for sharing information resources, across campus, across the country, and across the world. To maximize these resources, cooperation is the key. We need joint planning efforts on our campuses to integrate our information resource functions. Universities are in the business of creating and disseminating knowledge. The dawn of the information age has given us the opportunity to create a new and stimulating environment for knowledge and information exchange.

This new strategic orientation for managing technology has focused our attention on creating positive change and establishing new management paradigms. To do this effectively, we must develop a set of useful axioms to guide our planning efforts.

[1] See Blackmun's Chapter 3 discussion of several *CAUSE/EFFECT* articles that deal with this phenomenon, pages 23–26.

The Decade's Four Planning Axioms for Information Technology

Four axioms emerge from an examination of some of the outstanding articles about planning that have appeared in *CAUSE/EFFECT.*

Axiom 1: Planning for information systems must be linked to the institution's goals, and management information must support strategic thinking and decision-making.

Any strategic plan for managing information resources must support the institution's mission of delivering quality instruction, research, and service. In addition, planning and decision-making processes must be supported by accurate, timely management information.[2] This re :ization has become increasingly apparent in higher education during the past two decades.

Hollowell (March 1978) reported that in the early 1970s Boston University realized that "the operationally-based information systems of the growth oriented 1960s were not responsive to the need for management information in the 1970s." One of the basic premises in BU's methodology for information systems planning was "to insure that the ir formation systems are directly support:ve of and responsiv to the University's goals, objectives, and strategies. This pr actice is called the 'top down' approach to information syst ms design."

In his November 1984 article, Sherron confirme that planning must be the foundation supporting the institut.on's mission and goals. In contrast to the previous descriptions on strategic planning, Sherron advocated a "bottom-up" approach to setting organizational goals, beginning with individual departments or units and moving up to top management, noting: "Having grown from the ground up, they carry an air of expectation and can be labeled 'invented here.'"

Whether it begins at the department or with top management, setting goals for organizational direction must focus on the whole institution, not just the information technology department or the computer center. In her May 1987 article, Fleit advised that "one of the biggest problems we face is that computer people and non-computer people tend to define things differently." She wrote that we must use technology as a tool to support institutional goals and initiatives, but there should be "no more technology for its own sake." She pointed out that terms such as "increased productivity" and "more effective learning" have different meanings to different people within the campus community. These terms must be broadly defined for the entire community, not just the information technologists. Finally, she advised that we must first agree on the goals that we are going to use for campus computing, then we can work toward achieving these common objectives.

Hawkins (November 1987) echoed those sentiments in his article abo:t "selling" a campus computing plan:

> Falling in love with technology is dangerous, in that it has the potential of detracting from the basic objectives. A computing plan cannot be solely an esoteric dream statement. There must be balance and integration between the "vision" statements and the operational plans to implement those dreams.... Focusing on the ends (the academic mission that might be met more fully) has a better potential of selling a plan, if clearly articulated.

Keller (September 1986) emphasized the need to be aware of and plan for the "second-order consequences" of technology: "As universities introduce new technology into their programs and daily operations, it is important that they plan carefully so that novel technology enhances rather than disturbs the quality of campus services." By thinking ahead about the subtle effects of introducing new technologies, "higher education can use the high-tech inventions of the past years more wisely tu assist in achieving the perennial intellectual and artistic goals that higher education's leaders, not some technocrats, wish to achieve."

"A computing plan cannot be solely an esoteric dream statement. There must be balance and integration between the 'vision' statements and the operational plans to implement those dreams."

Axiom 2: Planning for information systems must include the commitment and involvement of individuals from all levels of the organization.

Strategic planning requires participation from individuals at all levels of the organization. Involvement is a crucial element in a proactive planning process and is necessary for the successful implementation of future strategies. By decentralizing the planning process, people at all levels contribute to the new vision, and their direct involvement motivates them to carry that vision out. A centralized decision-making process alienates those who are excluded, especially when they are the ones who are expected to implement the strategies.

In his July 1978 article, Parden addressed the benefits and cost of participative planning:

> One of the critical tests of centralized planning is whether or not the plans are ever implemented. It appears that if a plan (not just a budget) is put together by a central group without conflict or extended debate by the academic community, it will be difficult to implement because of resistance or just plain inertia. The resistance will be created by those who didn't participate in the centralized planning but are expected to implement it.

[2]See Dennhardt's Chapter 2 discussion of how information systems support strategic management and decision-making, pages 13-16.

"Overcoming resistance to change will be a major challenge for the information resource manager."

On the other hand, participative planning is time consuming and tension laden but has a greater chance of implementation because much of the conflict was resolved in the planning.

Decentralization of the planning and implementation processes does not assume that strong support from top management is unnecessary. On the contrary, it becomes even more of a necessity to have top management understand the importance and benefits of individual involvement. Corts and Prince (September 1980), in an article on management by objectives, stated:

> A clear statement of purpose with concise goals and definitive, measurable objectives is the foundation to developing planning and programs for any institution. Key to the successful building on this foundation is full support of your chief executive officer and senior administrators. With their active support the department level supervisors develop their goals and objectives to support university goals and objectives.

Penrod and Wasileski also subscribed to top management involvement: "Effective management information systems begin and end with good management. An absolute necessity of good management is involved managers." In that same article they noted:

> Three key factors which lead to sound decision-making are: (1) significant involvement from all levels of management, tying strategic planning, tactical planning, managerial control and the feedback/modification processes together in a synergistic manner; (2) systems designed to meet organizational needs, i.e., systems that can provide good, accurate and timely information, and that are adaptable to future needs; and (3) a communications network that ties subsystems together, contributing to points one and two by keeping information available that realistically addresses intrapersonal, interpersonal, organizational and data flow needs.

Finally, Lazarus made a case for the importance of executive involvement in administrative computing in a November 1981 Viewpoint article in which he described Boston University's use of an executive steering committee for information systems. He believed that executive involvement would mean more informed priority setting for developing applications of strategic importance to his University. Like Nolan, who proposed that executives could no longer be spectators where information technology was concerned, Lazarus wrote, "Administrators will have to have an appreciation of information systems and technology to remain effective in the 80s."

Axiom 3: Strategic plans must be flexible enough to adapt to changing technology, and organizations must be flexible enough to adapt to changing plans.

Planning is an exercise in adaptation and flexibility. The only constant in the information technology field is change. Strategic plans must be dynamic and flexible, providing the ability to adapt quickly to external conditions which affect internal goals and aspirations. With planning flexibility comes the organization's willingness to change with the plan. If the technology changes the plan, then the modified plan must change the way the organization works toward its goals. If this is not the case, strategic planning has been a wasted effort, since a plan is only as effective as its eventual implementation.

Evancoe's November 1980 article made this prediction: "The 80s will be a decade of increasing complexity, scarcer resources and more rapid change. These circumstances will force private institutions of higher education to do more formal and effective planning, or they will be hard pressed to survive." As predicted, the past decade has presented us with the challenge of balancing the need for technology with limited financial resources. Careful strategic planning is the method we use to perform this balancing act. And careful strategic planning means that we must anticipate, welcome, and encourage *change* on our campuses.

Penrod and Wasileski also made a prediction in their November 1980 article: "The 'winners' in the 80s will be those who can react quickly to good, accurate, timely information." Strategic planning and information systems were the key to this ability to react quickly to change. Strategic planning provides the framework for decision-making and for responding to new information, while information technology is the tool that moves the information from place to place.

Strategic planning inevitably brings about change from current practice. We have seen this repeatedly throughout higher education in the 1980s and the beginning of the 1990s. Institutionalizing change is a delicate process in any organization. As West pointed out (September 1980), overcoming resistance to change will be a major challenge for the information resource manager. To deal effectively with this challenge, managers must first understand the nature of change and the inevitable internal resistance. In his article, he quoted Kotter and Schlesinger:

> There are four basic reasons people resist change and there are various methods for dealing with each type of resistance. People resist change: (1) when they do not understand its implications and perceive costs greater than gains; (2) when they assess the situation differently; (3) because they fear they will not be able to develop required new skills and behaviors; and (4) when they think they will lose something of value.

West outlined three distinct strategies for ensuring flexible and adaptable strategic plans: "In dealing with future certainty, there is a need for commitment planning; in dealing with future uncertainties, there is a need for contingency plan-

ning; and in dealing with future unknowns such as natural, political, or technological changes and upheavals, there is a need for responsiveness planning."

Heterick (September 1986) also recognized the value of flexibility in planning efforts:

> Classical approaches to planning usually emphasize the establishment of goals. In a time where technology is growing and changing so rapidly, such a static approach is clearly myopic. What seems more fruitful is a strategic view of the institution's computing and communication future—a view that attempts to articulate a growth philosophy that permits seizing opportunities when the state of technology is right. Some technological advances are clearly predictable; others are not so easily foreseen. Whatever strategic position the institution assumes vis-a-vis computers and communications, it must be predicated on foreseeable technological advances, and flexible enough to accommodate those that are not so easily discernible.

In a more recent article (Fall 1990), Heterick concluded: "In an era in which the cost of chip technology is decreasing at about 25 percent per year—and the cost of higher education continues to outstrip the rise in just about everything other than medical care—we should be aggressively seeking targets of opportunity for that technology."

Axiom 4: The institution's strategic plan must guide the allocation of resources for information technology.

We have discussed in detail the importance and necessity of developing an institution-wide strategic plan to help achieve our goals and objectives. But a disturbing issue not yet addressed is that of dollars—where will the financial resources come from to implement our strategic plans? Although a good strategic plan will not magically create the money needed for its implementation, it can serve as a guide for wisely spending scarce resources. That's what strategic planning is all about—finding the best ways to use currently available resources and anticipating future requirements.

Several institutions in the mid-80s, among them the California State University and the University of California, undertook efforts to "institutionalize" funding for computing in the same way that other support services on campus are planned and budgeted for. In a May 1987 article, West proposed that there are two reasons why this issue persists for most campuses:

> First, most institutions have not developed a systematic way of identifying and translating future program needs into computing funding requirements which can be easily incorporated into the overall planning and budgeting process of the institution. Second, there is a dearth of national norms and standards which an institution can draw on to legitimize and institutionalize its requirements.

His article provided information about several campus efforts to establish budget formulae and material available from the CAUSE Exchange Library, documenting these efforts.

The question of how much computing is enough, originally raised by Richard Van Horn in a Snowmass Academic Computing Seminar address in 1980, was the subject of a March 1988 Current Issues article by Smallen, who suggested that "fundamental to getting a handle on how much should be budgeted for computing is having a sense of how important computing is to the mission of the institution." He wrote,

> Our trustees will be asking what we are getting for the continuing costs. The answer should be *services* which support the mission of the institution. Those of us who are responsible for the organizations that support computing activities must continually remind ourselves that if we are not providing such services we can't justify our existence—and the associated costs—no matter how spectacular the technology may get.

Similarly, Duckenfield (January 1981) discussed the issue of seeking resource commitments for information technology. He proposed a user-oriented view of campus information technology, which in turn would make available more money to support the computer center:

> Computer center management can no longer afford to think of the center as a special organization with goals distinct from those of the university as a whole. In order for computers to reach their full potential on our university campuses, they must be run and offered in such a way that they support their users. Only then will the computer center receive the support which they need themselves in order to continue to meet the demand for services.

"Computer center management can no longer afford to think of the center as a special organization with goals distinct from those of the university as a whole."

Little and Temares (January 1986) also addressed the issue of financing information technology, in an article that evaluated the success of the University of Miami's $15.2 million long range information systems plan:

> A fundamental challenge which has not been discussed appropriately in the literature is cost responsibility and containment. With hindsight, an earlier emphasis on target financial goals might have helped our users in their efforts to weigh the appropriate scope of the applications. A payroll system can be installed in as little time as a week, at a small cost, or it may require many months, at a much greater cost. Without specific financial guidelines from the outset, the establishment of project scope can exceed management expectations.

Conclusion

Throughout the last decade, the authors cited in this chapter made predictions about information technology issues. Perhaps an appropriate ending for this discussion on planning is to reflect back on those visions and contemplate their application over the *next* ten years.

In a September 1981 article that was recognized for its excellence through the first *CAUSE/EFFECT* Contributor of the Year Award, Robinson wrote:

Our universities face formidable challenges in order to cope with the new technology. The following are some internal factors which will affect their ability to do so:

- Demand for and cost of information resource services will increase in absolute and relative terms, but the technology will provide attractive tradeoffs.
- The pace of technological change will quicken steadily.
- Increasingly, departments will wish to acquire their own computer systems. Such action will continue to be condoned by funding policies of agencies such as NSF, which excludes computer centers from seeking funds for equipment for general campus use.
- Technology will bring the opportunity to realize many long-promised benefits to teaching including, toward the end of this decade, the opportunity to deliver instruction to diverse locations and settings.
- High turnover of staff and increasing reliance on junior and trainee-level personnel will increasingly affect university computing centers.

Heterick outlined his perspective on the future of higher education and computer and communications technology in his classic "single systems image" article in September 1986, establishing a vision that clearly has come to pass and continues to hold true:

- Increasingly, institutions will perceive their constituency to be off campus as well as on—the need to reach out across traditional boundaries will assume an increasing importance.
- Interconnection—the capability for human and machine linkages—will become an important issue in higher education.
- The fifth generation notwithstanding, the next round of technological innovation will occur in the communications, not computer, arena.
- The capacity of the institutional budget to absorb continuing developments in computing and communications is significantly attenuated.

The 90s will promote even more widespread organizational changes than we have seen over the past decade, and information technology will continue to play an essential role in this evolution. As the pace of change quickens, we must reaffirm our commitment to sound planning and evaluation to guide today's decisions toward tomorrow's dreams.

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