Approved January 25, 1983
Date

MINUTES OF THE House COMMITTEE ON Communication, Computers and Technology.

The meeting was called to order by Representative Mike Meacham at
Chairperson

3:30 a.m./p.m. on January 18, 1983 in room 531-N of the Capitol.

All members were present except:

Committee staff present:
Sherry Brown, Fiscal Staff, Research Department
Chris Stanfield, Fiscal Staff, Research Department
Arden K. Ensley, Revisor of Statutes
Betty Ellison, Secretary to the Committee

Conferees appearing before the committee:

Bill Belleville, Acting Director, Division on Information Systems and Computing (DISC).

Chairman Meacham made several announcements:

1. Minutes will be taken up in the first meeting of the week, those minutes being of the previous week's meetings.

2. Beginning the week of January 31, the committee will meet three days a week, on Tuesdays, Wednesdays and Thursdays.

3. In the next few weeks the committee will take up the following:

   Week of January 24 - Speakers on biotechnical research in Kansas

   Week of January 31 - Instructional and public television

   Week of February 7 - Divestiture of the telephone system and the break-up of AT&T

   Week of February 14- Telecommunications plan from the Office of Telecommunications in the Department of Administration

   These units will be introductory so the committee will understand the terms and the issues. After each of these areas has been completed, the staff will prepare a summary of some of the activity and some of the testimony, for the purpose of pointing out what policy issues have been raised. Those summaries will be the size of bill briefs and will be placed in the bill books for easy future reference.

4. The field trips that have been mentioned in the past will generally wait until after March 11 which is the deadline for consideration of bills in their house of origin. An exception to that is, there are a couple locally aside from DISC; KTWU, the public television station here and the KANS-AN system. The committee will view those on some Monday. These field trips will be taken on Mondays at our regular committee time since they are local and easy to get to.

The chairman introduced the conferee, Mr. Bill Belleville, who distributed some informational material regarding DISC, industrial use of computers, and computer terms. (Attachments 1, 2 and 3)

Unless specifically noted, the individual remarks recorded herein have not been transcribed verbatim. Individual remarks as reported herein have not been submitted to the individuals appearing before the committee for editing or corrections.

MINUTES OF THE House COMMITTEE ON Communication, Computers and Technology,

room 531-N, Statehouse, at 3:30 ~~a.m.~~/p.m. on January 18, 1983

Mr. Belleville gave some personal background, stating that he began working in the State of Kansas in June of 1981. He also gave a history of personnel in DISC as follows:

> Mr. Diggins, hired by the 1980 Legislature for DISC, stayed two weeks. Dr. Dick Mann handled DISC on a part-time basis 1980 - May, 1981. Mr. Jerry Magnuson was the first basic director; he left in September, 1982. Mr. Belleville has been acting director since that time.

Mr. Belleville stated that many people in data processing are more loyal to the profession than to the employer; there is much competition for higher pay. Representative Rolfs asked how state government can contain cost and still keep people. Mr. Belleville replied that long-range planning and identifying requirements are important; it is necessary to search for the right fit.

Mr. Belleville gave several examples showing how the technological evolution will affect everyone. We will have to learn to use computers at home, school and in the workplace. The video, auto and tire industries are in robotics; this will cause a major social change, displacing many people at jobs. Office workers will be affected as word processing replaces secretaries; the cycle feeds upon itself. He commented that use of computers by voice is in the future. Computers will be smaller but more expensive. Microcomputers are replacing the slide rule and calculators.

Chairman Meacham asked for a motion on the minutes of January 11 and 12, 1983. Representative Rolfs moved they be approved. Representative Aylward seconded the motion and the motion carried.

The meeting was adjourned by the chairman at 4:30 p.m.

The next meeting of the committee will be at 3:30 p.m. on January 19, 1983.

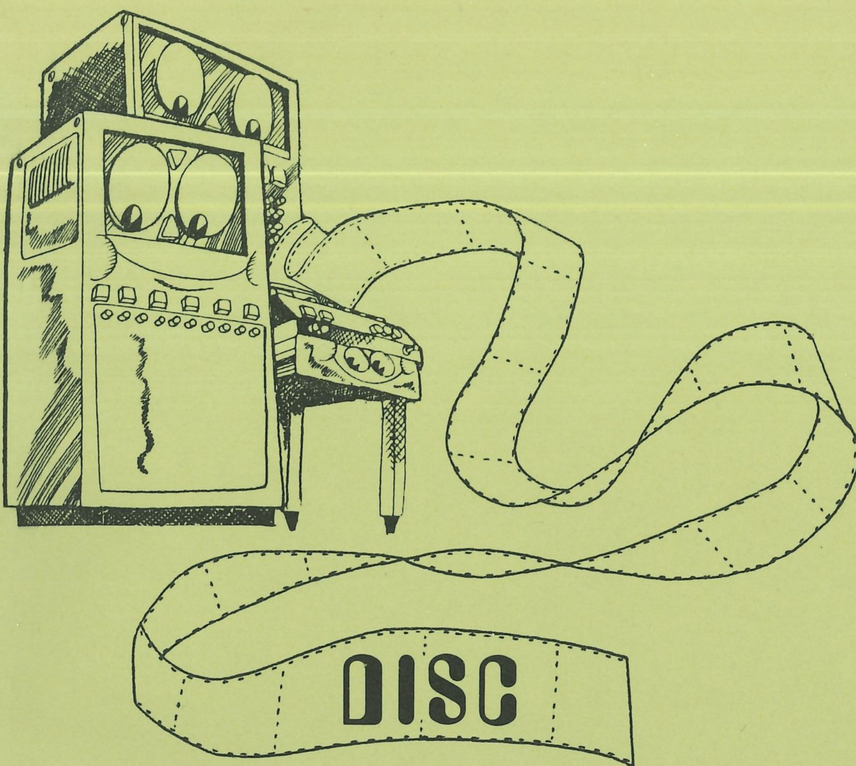
Date: Jan. 18, 1983

GUEST REGISTER

HOUSE

COMMITTEE ON COMMUNICATION, COMPUTERS AND TECHNOLOGY

NAME	ORGANIZATION	ADDRESS
LORI GOERING	KCC	4TH FLOOR S.O.B.
Dave Larson	KCC	4th Floor "
RUU CHANG	KCC	" " "
Mark Levy	Legislative Post Audit	3rd Fl. Mills Building
Gloria Timmer	Legislative Post Audit	3rd Floor Mills Bldg.
BILL Belleville	DISC	11th Floor SOB
J. CAREY BROWN	DISC	11TH FLR SOB
Carmel Hinkle	SPERRY	3601. 29th
Terry Copeland	Sperry	4210 Johnson Dr. Fairway KS



Division of
Information Systems and Computing

Department of Administration

State of Kansas

Attachment 1

House Communication, Computers and Technology 1/18/83

Division of

Information Systems and Computing

11th floor
State Office Building
Topeka, KS 66612

(913) 296-3343

1st Edition - January 1983

Table of Contents

Introduction

The Division of Information Systems and Computing (DISC) is the central data processing authority for the State of Kansas. Located on the 11th floor of the State Office Building in Topeka, DISC provides centralized computer services and management.

Statutory Responsibility

DISC was established by the 1980 Kansas Legislature. It was designated the central authority in determining and providing the necessary data processing services for State agencies. Agencies thereby are required to obtain DISC's approval prior to acquiring data processing hardware, software, programs and personnel.

DISC also is responsible for auditing agency compliance with established standards and for reviewing and making recommendations to the Division of Budget on agency data processing plans and budgets.

Organization

Office of the Director

The Director of DISC reports to the Secretary of Administration in his exercise of the authority granted the Division. He is guided by the Information Systems Policy Board (ISPB) in meeting statutory responsibilities and the Information Systems Advisory Committee (ISAC) in fulfilling the information system needs of the Department of Administration.

The Director is supported by a special Planning and Control staff and four assistant directors.

Administrative Services

The Assistant Director for Administrative Services and staff conduct internal business and office management services.

This section supports DISC by performing key functions including budget preparation, accounting and billing, contract initiation and management, mail/distribution control, word processing and clerical services, personnel/payroll administration, purchase control, records maintenance and DISC security.

Agencies interact with this staff to establish data processing service accounts and discuss charges for services.

Computer Operations

The Assistant Director for Computer Operations and staff maintain three large computers and associated equipment (hardware). This section operates several extensive data communications networks connecting local and remote terminals which serve users within their individual offices.

Other users receive computer services by coordinating with the production control staff who handle the magnetic tape, printed forms and other selected media.

Agencies interact with this staff to install terminals, request hardware maintenance, report hardware and communications problems for resolution, request job production and retrieve output.

Technical Support

The Assistant Director for Technical Support and staff install and maintain the computer systems software and related packages that control the hardware.

This section ensures the effective use of the operating systems, communications packages, data base management systems, source program translators/compilers/assemblers, utility packages, user-friendly software, mathematical/statistical packages, job billing packages and capacity management features.

Agencies interact with this staff to access available software packages and be advised on their use, report problems for resolution and receive expert consultation on software facilities and features.

Systems Design and Development

The Assistant Director for Systems Design and Development and staff develop and maintain applications to solve user problems.

This section evaluates user needs for cost/benefit effectiveness, designs, develops and maintains automated systems, prepares and implements statewide development methodology and standards, provides expert consultation in the effective design of systems and advises agencies on obtaining information systems training.

This section also operates a Documentation Library to store system and program documentation and an Information Center providing user-friendly software (including graphics) to help users help themselves.

Agencies interact with this staff to determine if automated tools can help them do a more cost-effective job.

Planning and Control

The Assistant to the Director for Planning and Control and staff provide special assistance to the Director by coordinating the State's long-range automation plan, setting guidelines for the preparation of data processing budgets and reviewing agency data processing plans and budgets.

This section also evaluates the effective use of data processing methodology and standards, reviews the appropriateness of data processing hardware and software (including word processing and mini- and micro-computers) and audits agencies on the proper use of their capabilities and features.

Agencies interact with this staff to plan for their systems needs, obtain approval for hardware and software and receive expert advice and assistance in justifying their needs.

Charges for Services

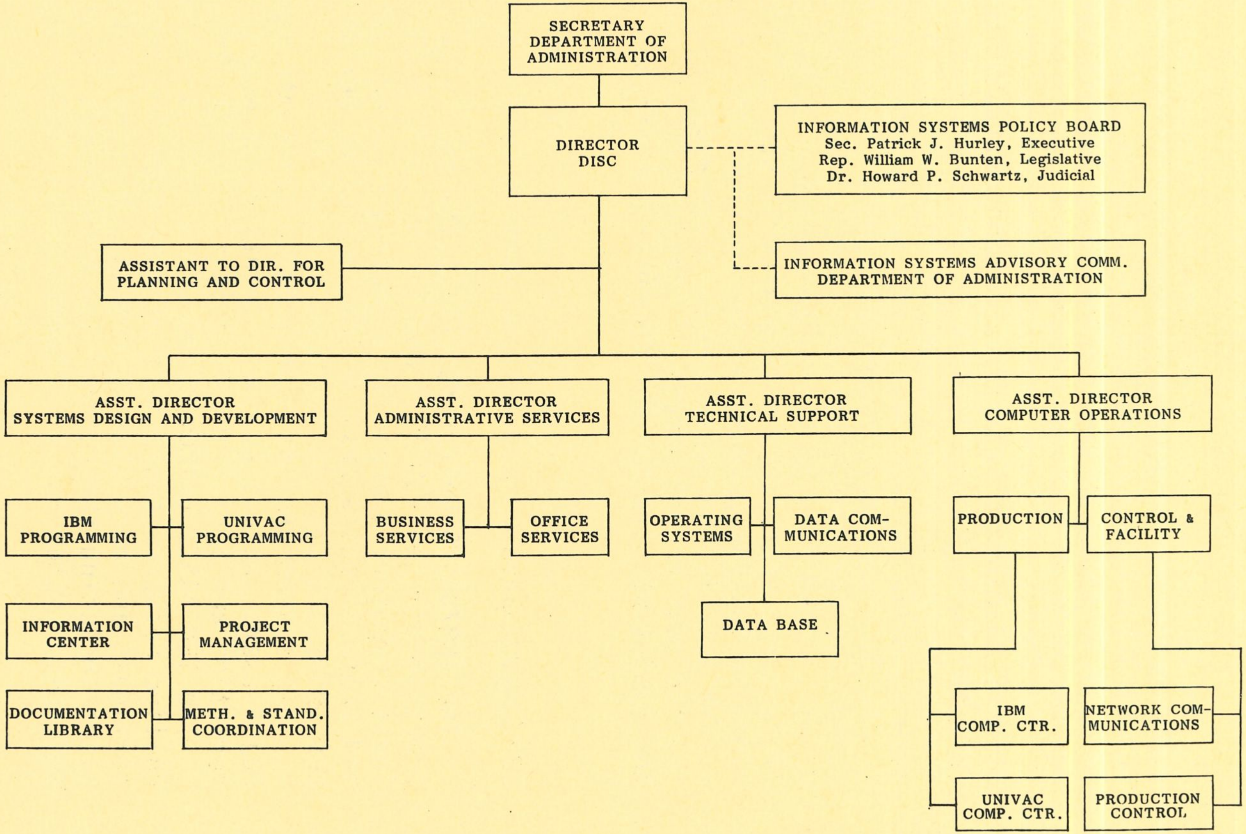
DISC recovers all costs for services rendered to users. Charges are determined by such factors as time of day, analyst/programmer time and software accessed.

Rates are published annually with revisions made only when necessary to recover costs.

For the current rates, see the most recent update of Policy and Procedures Memorandum 103 or contact the Assistant Director for Administrative Services.

DIVISION OF INFORMATION SYSTEMS AND COMPUTING
(DISC)

Department of Administration



Computing Facility

The IBM/NASCO and Univac Computer Center has a full complement of data processing utilities, from sophisticated data base/data communication facilities to user friendly software oriented for direct use by agency staff with minimal training.

The Center performs capacity planning and performance tuning to determine current workloads and computer resource utilization. Future requirements are projected in order to tailor hardware and software to optimize the quality of the services rendered.

The DISC Computer Center operates 24 hours per day, seven days per week. Hardware and software maintenance is conducted on Sunday between 6 a.m. and noon. If required, emergency maintenance is scheduled to minimize interference with user on-line activity.

For specific hardware and software availability, see the most recent update of Standard 200 or contact the Assistant Director for Computer Operations.

IBM/NASCO System

The IBM/NASCO system functions via two large processors: the IBM 3033 and the NASCO AS 5000. These computers operate as a loosely coupled system and share direct access devices and other peripheral equipment.

This system provides services to all State agencies. Major users include the Departments of Revenue, Transportation and Social and Rehabilitation Services.

The IBM/NASCO system currently maintains extensive on-line networks consisting of more than 600 remote terminals and more than 20 remote job entry (RJE) sites including the central law enforcement message switching system for the State.

IBM/NASCO System Hardware

IBM hardware

1 - 3033 Model N processor (12 megabytes of memory/12 channels)

2 - 1403 Model N1 printers (1100 lines per minute)

6 - 3274 video controllers

1 - 3705 Model B_2 communications controller

1 - 2540 reader/punch

National Advanced Systems hardware

1 - AS 5000 processor (6 megabytes of memory/6 channels)

1 - Beall channel switch

Storage Technology Corporation hardware

24 - 8350 disk drives (317.5 megabytes each)

28 - 8650 disk drives (635 megabytes each)

Telex Corporation hardware

15 - 8020 Model 5 magnetic drives (1600 bits per inch/6250 characters per inch)

1 - 8020 Model 5 magnetic drive (800 bits per inch/1600 characters per inch)

ITT Courier hardware

2 - 2722 video controllers

1 - VTLC video controller

The IBM/NASCO computers run on the IBM/MVS operating system. Input and output operations are controlled by JES2, an IBM product.

Terminals are scheduled and controlled by one of three IBM Telecommunications Access Methods: TCAM, VTAM and BTAM. On-line files and applications programs are scheduled and controlled by two data communications packages: the IBM Customer Information Control System (CICS) and the CINCOM Environ/1 (E/1). CICS applications programmers use COBOL and NATURAL computer languages while E/1 programmers use TBOL and MANTIS.

In addition, CINCOM's TOTAL and Software AG's ADABAS (data base management systems) are available for systems development. TOTAL operates with both CICS and E/1 while ADABAS operates only with CICS.

Program development productivity aids available are ROSCOE and LIBRARIAN. ROSCOE is used to create and modify program source code on-line. LIBRARIAN stores the source code and job control language statements.

Univac System

The Univac system functions via a Univac 1100/62 multi-processor which allows for continued processing in a degraded mode if one of the processors fails.

The Univac system is primarily dedicated to the Department of Administration. Current major projects include the Central Accounting System of Kansas (CASK) and the Kansas Integrated Personnel/Payroll System (KIPPS).

This system currently maintains an extensive on-line network of approximately 220 remote terminals and one remote job entry (RJE) site.

Univac System Hardware

Univac hardware

1 - 1100/62 multi-processor (1048 KWords/ 10 channels)

8 - 0874 magnetic tape drives (1600 bits per inch/6250 characters per inch)

2 - 0776 printers (1200 lines per minute)

1 - 0176 card reader

16 - 8470 disk drives (89.6 MWords each)

1 - GCS communications controller

Univac System Software

The Univac multi-processor runs on the Exec 1100 operating system. Primary data communication services are provided through three versions of MAPPER, a user-friendly product designed to facilitate information manipulation and retrieval by users with minimal training.

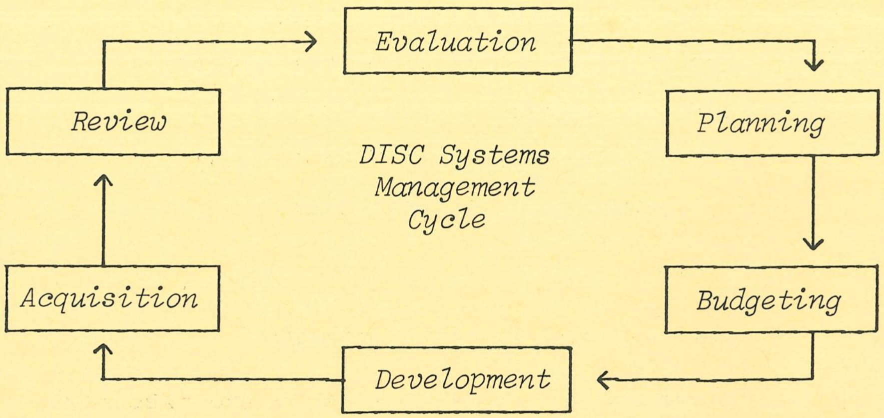
MAPPER is administered through delegation of MAPPER coordination responsibilities, creation of modes and types and routine file re-organization. Proposed record structures are reviewed constantly and users are advised on MAPPER design and coding techniques.

Additional services are available on the Univac system through the use of the Communications Management System (CMS), DMS 1100 (a data base management system) and the Univac Terminal Security System (TSS).

Univac program development productivity is enhanced by the use of Conversational Time Sharing (CTS), an on-line text editor/compiler used to store source code and job control language statements.

Developing Your Information System

DISC can help your agency create an information system tailored to your needs via a management cycle consisting of six phases:



Evaluation

Once the user staff of your agency has determined that an automated system is needed, a detailed written evaluation of your needs should be prepared. The length of the document will depend on the complexity of your needs.

Although this evaluation is normally conducted by the user, DISC can provide special assistance upon request. Such teamwork in the early phases of the cycle can increase the likelihood of achieving the appropriate system.

Planning

Next, your agency should prepare (or update) its data processing plan, detailing the computer resources necessary to establish your new information system.

If appropriate, DISC then estimates the additional resources needed to support the development, maintenance and/or processing of your new system.

All individual agency plans are coordinated by DISC to create a single three-year State Data Processing Plan which identifies the State's total automation needs.

The Information Systems Policy Board (ISPB) annually reviews the State Plan, providing guidance and direction.

Budgeting

An important step in the cycle is obtaining adequate funding to execute your information systems plan. Agencies prepare and submit their fiscal requirements annually to the Division of Budget. DISC then reviews the data processing portion of these budgets for consistency with the overall State Plan.

Following legislative review and adjustment, agencies and DISC finalize their budgets and begin implementing the approved automated systems.

Development

Once funds are allocated, your agency should submit a service request (if appropriate) for the new system, modification and/or enhancement. At this time, DISC will assist your agency to analyze your problems and needs and schedule the tasks to be accomplished.

DISC then designs your system and details how its features work and what they will do. DISC will provide you with a more accurate estimate of your costs at this point. With your approval, the Division then will write the programs, prepare the necessary documentation and test the new application.

In some instances, your agency's needs may be better achieved through the DISC Information Center. If so, the Center Coordinator will assist you in the development and execution of your system.

Hardware and Software Acquisition

Generally, new applications require new hardware and software. If so, DISC will assist your agency to procure and install them.

The procedure for acquiring new hardware and software is detailed in the most recent update of Policy and Procedures Memorandum 104.

Review

Once your new information system is operational, your agency's management staff should review its effectiveness. DISC will assist you if fine tuning is required.

Major modifications and enhancements are implemented by repeating the cycle.

User Help and Information Sources

User Help Desk

Users having hardware or software problems should report them to the User Help Desk. Any problems that cannot be resolved immediately will be forwarded to the appropriate technician.

The purpose of the Help Desk is to provide change control and problem tracking to assure more reliable and consistent computer services to DISC users.

Information Center

The Information Center provides users the opportunity to develop and execute their own systems applications through the use of computer productivity packages. Obtaining assistance from the Center will help reduce the need for additional programming resources and eliminate data processing backlog within the user agencies.

Computer packages available include text processing, on-line training and user-friendly software.

Other services of the Information Center include product education, technical and operational support, problem resolution assistance and general consultation.

Contact the Information Center Coordinator for a copy of the Information Center Handbook and other assistance.

Production Control

User agencies which do not have a production control staff must schedule their batch production jobs through the DISC production control staff. Job submissions must meet pre-determined production schedules.

The DISC production control staff maintains two magnetic tape libraries. The Univac library is managed by the DISC tape librarian and contains approximately 1,000 reels of tape in active status.

The IBM/NASCO library has approximately 18,000 reels of tape in active status and is managed by the following agency tape librarians:

Series	*T002000 - T009999*	*DISC*
	T010000 - T019999	*Social & Rehabilitation Services*
	T020000 - T029999	*Transportation*
	T030000 - T039999	*Revenue*

In addition, DISC operates two secured off-site magnetic tape storage vaults which are available to users.

Documentation Library

The Documentation Library provides a central location for all system and program documentation implemented by DISC. Documentation submitted to the Librarian is verified for completeness and accuracy before being added to the library inventory. Access to the documentation is controlled by the Librarian.

In addition, various software manuals and all DISC publications to users may be obtained through the library.

For more information, contact the Documentation Librarian.

User Meetings

DISC conducts periodic meetings for all State agencies who use DISC services. From these meetings, user groups have been formed around specific software packages to improve the ability of users to utilize DISC data processing resources.

These smaller groups meet periodically to share information and foster cooperation among user agencies. They also provide DISC with feedback from the user community.

The MAPPER user group is the largest and consists of all software coordinators for projects using MAPPER applications. These coordinators provide the interface between actual users and those who develop and support the application of MAPPER.

Similar user groups have been formed around the data base management systems and ROSCOE/LIBRARIAN software.

DISC Publications

Policy and Procedures Memorandums (PPMs) inform user agencies of established DISC policies and procedures.

Standards are basic tenets established or adopted by DISC which remain relatively unchanged over time. They closely resemble PPMs in content but are somewhat more technical.

Guidelines provide a how-to approach to users on compliance with the policies set out in PPMs and Standards. Practical examples often are included.

Bulletins announce short-term alterations to normal operating conditions. They normally have a definite expiration date or a clear short-term purpose. Bulletins also announce upcoming events of potential importance to the DISC user community.

Standard Operating Procedures (SOPs) set forth internal policies and procedures for the DISC staff and do not have a direct impact on users.

Copies of these publications may be obtained from the Documentation Librarian.

DISC Directory

Main Office 296-3343
Director
Assistant Director for Administrative Services
Assistant Director for Computer Operations
Assistant Director for Technical Support
Assistant Director for Systems Design & Development
Assistant to the Director for Planning & Control

Administrative Services 3343
Reception/Office Services 3343
Business Services 4111
Personnel Services 2772

Computer Operations 3343
IBM/NASCO Computer Center 3139
Facility Supervisor
Production Supervisor
Univac Computer Center 7867
Facility Supervisor
Production Supervisor
User Help Desk 2310
Production Control 5267
Systems Status (recorded message) 2300

Computer Operations Managers
IBM/NASCO & Univac Operations 2699
Production Control & Physical
Facilities 2927

Technical Support 3343

Systems Design & Development 3343
Methodology, Standards & Training
Coordination 4113
Information Center 2323
Documentation Library 2514

Planning & Control 3343

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Topeka, Kansas 66612

THE WALL STREET JOURNAL.

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VOL. LXIII NO. 66 ★

Campus Glitch

Universities in U.S. Are Losing Ground In Computer Education

Lack of Funds Leaves Schools With Too Few Teachers And Inadequate Facilities

Industry Gives Helping Hand

By CAROLYN PHILLIPS
Staff Reporter of THE WALL STREET JOURNAL

URBANA, Ill.—It hadn't seemed like an impossible dream. After two years at Eastern Illinois University in Charleston, David Gerdes decided to transfer to the University of Illinois here to study computer engineering. He had the science and math courses that the University of Illinois requires for admission. He had good grades from Eastern—almost a B average. He had A's in all his computer-programming classes.

But with qualifications considerably better than average, 20-year-old Mr. Gerdes can't get into computer engineering at Illinois. There isn't room.

Even though overall enrollment is dwindling, U.S. colleges and universities can't accommodate the hordes who want computer education. Good students are denied admission as many schools cap enrollments at levels that already strain teaching staffs and overtax facilities. In fact, some educators say that to guarantee quality instruction, they would have to reduce current enrollments in computer courses by 25%. Meanwhile, employers lament that only 50,000 graduates were available last year to fill more than 115,000 computer-related jobs.

"This country could blow what is a terrific world lead in computer technology by failing to graduate enough people with the capability to maintain it," warns Robert G. Gillespie, the vice provost for computing at the University of Washington in Seattle. But without money to augment inadequate facilities and increase staff sizes and salaries, recession-whipped schools will continue to produce insufficient numbers of computer-trained graduates and will fail to effectively introduce the computer as a learning tool in nonquantitative disciplines.

Awkward Choices

The conditions force would-be students of computer sciences or computer engineering to make some awkward choices. Mr. Gerdes, for instance, is enrolled in the college of arts and sciences at Illinois and is trying to raise his 3.9 grade-point average to 4.2, the current cutoff on the five-point scale for the admission of transfer students into the engineering program. James N. Snyder, the head of computer science at Illinois, calls 4.2 "ridiculously high" as an entrance requirement. The required grade for general admission to Illinois is 3.25.

Mr. Gerdes's chances for admission to engineering at Illinois "are probably diminishing instead of increasing," says Gary R. Engelgau, the director of admissions and records. By the time Mr. Gerdes attains a 4.2, if he ever does, the cutoff point could be pushed higher, as thousands more students continue to compete for the limited number of places. "You have to be a genius to get in," says Mr. Gerdes.

Life on the inside makes other demands—including patience. During peak periods, as at many institutions, students wait hours to use a computer terminal for sometimes just a few minutes. They also stand in long lines to talk to a professor or a teaching assistant about computer assignments. One of the biggest computer-education headaches is that classes fill up so fast students can't always get into the courses they need to graduate; as a result, a traditional four-year degree often takes an extra term or two for some students to complete.

Teaching overcrowded classes is no more fun than taking them. "Clearly, the ideal situation would be for me to have two students come to my office and have tea or sherry and talk things over," says C.L. Liu, a professor of computer science at Illinois. Instead of tea for two, Mr. Liu has 200 to teach. He does concede, however, that such a large group isn't necessarily a bad thing. "I think I am able to have some dialogue with large classes. I prepare better for them. I psych up a lot more, and I'm more animated."

Watered-Down Education?

Mark Ardis, an assistant professor at Illinois, taught 18 students in a software-engineering course the first time the class was offered a few semesters ago. The second time the course was offered, 42 students took it. Mr. Ardis recently saw registration figures for the third offering of the class—126 students signed up. "There isn't much change in my presentation of material, whether I'm talking to 10 or 120," Mr. Ardis says. "What changes is the work done by the students. With a smaller group, I assign work I will look at and take an active role in grading. But with so many students, I will now give out assignments that only graduate teaching assistants will see." He adds: "I think you water down the education when enrollment goes up."

The Accreditation Board for Engineering and Technology thinks so, too; it granted 31% fewer six-year accreditations this school year than last to academic programs in engineering. The board looks at a number of factors—faculty, laboratory facilities, financing and others—in determining whether a program is accredited for six years, three years or not at all.

The University of Illinois has maintained accreditation for its engineering programs. "But we do see a deterioration in quality in a general sense," says Edward Ernst, the school's associate head of electrical engineering. "Faculty overload is the big problem. But we also aren't able to keep up with the equipment we need for general instruction in engineering, especially in the computer areas. It's a matter of having twice

Please Turn to Page 12, Column 1

Attachment 2

House Communication, Computers and Technology 1/18/83

Campus Glitch: As Direct Result of Money Shortage, U.S. Universities Fall Behind in Computer Education

Continued From First Page

the number of students with no additional resources."

Supply and Demand

Throughout the country, educators marvel at how quickly student use of computer facilities expands to fill available capacity. "It's like the Santa Monica Freeway—expected to handle traffic for 20 years and overrun in one," says Joel Moses, the head of electrical engineering and computer science at Massachusetts Institute of Technology. Robert Knight, the manager of Stanford University's LOTS (low-overhead timesharing) computer facility, says, "You'd probably be hard pressed to find a school that is keeping up with student demand for computing capacity. To meet that demand you'd have to spend extraordinary sums of money."

Extraordinary sums of money are being spent on university computer use—$1.3 billion a year, from the most recent estimates. "But more than half of that is for administrative purposes, not instruction or research," says Mr. Gillespie at the University of Washington. The amount spent on academic computer work translates into about $20 per student per year, only one-third the $60 per student that was recommended in a 1967 report by the president's Science Advisory Council.

Even at the best schools, under-investment in computers for instruction results in penny-pinching compromise. At Stanford, Mr. Knight says, "We're probably a little bit behind the times in terms of whiz-bang hardware," because the computer facility there just bought a second machine identical to the model it bought in 1976. Sticking with the same machines meant the facility could use the same software and staff—two areas where costs are much higher than hardware costs. Although the purchase doubled the capacity of Stanford's LOTS facility, Stanford's vice provost Gerald Lieberman says student use increased accordingly. Mr. Lieberman projects LOTS will have to double capacity again—adding two more machines—in three years, if not sooner.

Most schools tolerate a certain degree of antiquation in the machines they use in general computer-center facilities, citing capacity as the more important concern. (Specific academic departments may buy more modern machines for exclusive research or academic use.) But many schools question whether the limited capabilities of yesteryear's computers are adequate, even for instruction. "We have to give students a sense of what the field is like today, not what it was like 10 years ago," says Kenneth W. Kennedy Jr., professor of mathematical sciences at Rice University in Houston.

Providing sheer capacity (enough terminals, enough computer power) constitutes challenge enough for computer-center staffs as they serve the needs of traditional student users—business, science and engineering majors for whom the computer is often the subject of study. But many blanch at the thought of having to provide adequate facilities for all other students, too—students in literature, theater, history, religion, sociology and other disciplines who could use the computer, not for manipulating numbers, but for processing information. Educators see that as the next crest, an innovation in education termed a revolution by some. "But unless something changes drastically, the nation's best universities won't take part in this revolution," says Douglas Van Houweling, the vice provost for computing and planning at Carnegie Mellon University in Pittsburgh.

Still, the most pressing problem in computer education is not machine obsolescence or lack of capacity or under-use of computers in nontraditional areas. The toughest problem remains the computer manpower shortage. Because of the short supply, industry offers high salaries that entice students with two-year, four-year or master's degrees into the workplace. So few students continue for the doctoral degree that the pool of people qualified to teach computer courses is drying up.

An American Association of Engineering Societies survey shows that computer-science and computer-engineering departments report a 17% vacancy rate—at a time when the 9% vacancy of engineering-faculty positions is considered a crisis. Jack Gells, a project director at the association, says that almost two-thirds of the vacancies in the computer-related departments date from a year ago or longer. Mr. Ernst of the University of Illinois adds: "More money alone to hire more faculty in computer science wouldn't help. We can't find anybody."

Salary Disparity

Only about 250 people a year complete doctoral degrees in computer sciences, and that number has been decreasing 6% to 8% annually, says John Hamblen, a University of Missouri professor on leave to the National Bureau of Standards. In the competition for those graduates, universities lose the salary bid. "A person with a two-year degree can get a programming job for $20,000 to $22,000 a year in industry," estimates Andrew Molnar, a project director at the National Science Foundation. "A person with an eight-year Ph.D. might make $20,000 to $21,000 a year as an assistant professor."

The drawing card that universities once had—an ambiance conducive to scholarly thinking and research—is deteriorating in computer disciplines. Illinois assistant professor Mark Ardis says, "It's hard to stay at a university when there are offers from industry at two or three times your salary and better research equipment, too. And besides teaching and trying to do research here, I advise about 85 students. For the first few weeks of the semester, there is a student outside my door every minute of the day. No one gives tenure for advising students." Mr. Kennedy at Rice warns, "You can't let faculty get buried or they will leave."

Aware that it has been eating its own seed corn, industry has moved to remedy part of the manpower problem in colleges and universities. The American Electronics Association and some of its members—most notably Hewlett-Packard Co. of Palo Alto, Calif.—have developed a fellowship program designed not only to increase the number of doctoral students in computer sciences and electrical engineering but also to encourage the students to take teaching jobs after graduation. (The program waives part of the cost of a doctorate if the graduate takes a university faculty position after receiving a degree and waives the whole cost if the position is held more than three years.)

"We know if we don't make an investment in the development of engineers, then we won't have an industry, at least not one that's competitive internationally," says Patricia Hill Hubbard, president of the American Electronics Association's Electronics Education Foundation. She adds: "We also know that we're already late. We should have been doing this five or six years ago."

Fellowship Programs

A number of companies—Xerox, Standard Oil of Indiana, Control Data and others—have introduced fellowship programs, faculty research programs, equipment grants and other means of helping higher education train high-technology workers. Many schools are watching closely a joint venture between International Business Machines Co. and Carnegie Mellon that will result in each student and staff member at the

THE WALL STREET JOURNAL
January 14, 1983

institution having a computer work station.

Colleges and universities are also beginning to see the necessity of increased support of computer education from within. "They see that a good computing facility is similar to a library. It's something without which a university can't exist," says John G. Kemeny, a professor of mathematics and former president at Dartmouth College in Hanover, N.H. The University of California system attacked the faculty-salary problem directly by raising engineering-, business- and management-faculty salaries across the board: 20% for assistant professors, 10% for associate professors and 5% for full professors.

In time, predicts John Hamblen of Missouri, the manpower shortage will work itself out—to a certain extent. He believes that as industry is saturated with two-year-degree holders—as is happening now—more students will go on for the four-year degree. He worries, however, that the process won't correct the doctorate shortage for a long while.

But Mr. Gillespie at the University of Washington questions whether colleges and universities, even with industry help and the factor of time, will effectively absorb changes the computer is bringing to education, without some sort of national agenda. "The computer affects the foundations of American education in a way that means we should reexamine how we provide that education," Mr. Gillespie says. "We're floundering right now because there's a need for the federal government to provide resources and information policies. That lack of direction on a national level has us standing at the edge of a cliff."

Attachment 2

House Communication, Computers and Technology 1/18/83

A Short Guide To Computer Terms

ACCESS TIME. The period of time between calling for information from memory and the delivery of that information. Disk storage is generally faster than tape storage.

ACOUSTIC COUPLER. A device attached to a computer terminal to transmit and receive audio tones via telephone lines. A type of modem. See MODEM.

ARCHITECTURE. The internal, present arrangement or organization of a computer that determines how the computer operates.

ARTIFICIAL INTELLIGENCE: A branch of computer science aimed at developing machines capable of carrying out functions normally associated with human intelligence (e.g., reasoning, self-correction, adaptation).

BASIC. An acronym for Beginners All-Purpose Symbolic Instruction Code. A high-level conversational, interpretive, programming language in wide use. Always written in capital letters, BASIC permits the use of simple English words and common mathematical symbols to perform the necessary arithmetic and logical operations to solve problems.

BAUD. A rate of information flow. Given in bits per second (BPS), the rate is the highest number of single elements (bits) that a microcomputer, word processor or computer is capable of transferring in one second to another device. Alphabetic characters, for example, being transferred at 300 baud correspond to about 30 characters per second. Common baud rates are 110, 150, 300, 600, and 1,200 bps.

BINARY CODE. A code that uses only zeros and ones to represent data. 10110011, for example, may represent the letter C.

BIT. Binary Digit. The smallest unit of digital information.

BOOT: Short for "bootstrap." The process of loading the operating system of a computer into main memory and commencing operation.

BRANCH. A place in a program where a choice is made to depart from the normal sequence of program instructions. The departure is made by a "branching instruction" in the program. A branching instruction may be one of two types: conditional or unconditional.

BUFFER. A space in a computer system where information is temporarily stored. Usually used to store small sections of data during a transfer process. For example, data may be read from a tape cassette in small units, placed in a buffer, then transferred to main memory when the computer is ready to process the data.

BUG. An error in programming which causes faulty output. May also mean a hardware malfunction or design error in the computer or in its peripherals.

BYTE. A basic unit of information in a computer. Commonly consists of a sequence of eight binary bits, usually handled as a unit. One byte usually represents one character.

BPS. Bits per second.

CASSETTE RECORDER. A device for storing information. Because most computers lose the information stored in them when they are turned off, a means of keeping the information is necessary. Binary information is stored on a cassette tape by first converting it to audio signals and recording it on the tape. This method of storage is slower than disks.

CHARACTER. Single items that can be arranged in groups to stand for information. There are two forms: 1) numbers, letters, graphic symbols, etc., that can be understood by human beings; and 2) groups of binary digits that can be understood by the computer. A character is usually represented by one byte.

CHIP. A small, flat piece of silicon on which electronic circuits are etched. The heart of a microcomputer, this microprocessor contains all the circuitry to carry out computer operations.

CODING. Developing a set of computer instructions.

COMMAND. An instruction given to the computer through an input device or peripheral.

COMPATIBILITY. There are two types of compatibility: software and hardware. Software compatibility refers to the ability to run programs on a variety of computers without changing the program language. Hardware compatibility means that various components (printers, disks, keyboards, etc.) may be connected directly without intervening electronic devices and that all components use the same baud rate, word length, and other technical aspects in order to communicate.

COMPUTER. A device designed for the input, storage, manipulation, and output of symbols (digits, letters, punctuation). It can automatically follow a step-by-step set of instructions to manipulate information. The set of instructions and the information on which the instructions operate usually vary from one moment to another. The difference between a computer and a programmable calculator is that the computer can manipulate text and numbers; the calculator can manipulate only numbers.

COURSEWARE. A combination of content, instructional design, and the physical program, software, which causes a computer to complete instructions.

CPU. The Central Processing Unit. The CPU controls what the computer does. It includes three main sections: arithmetic, control, and the logic elements. It performs computations and directs the functions of the computer.

CRT. The Cathode Ray Tube is similar to a television screen. The CRT terminal usually is accompanied by a keyboard used to enter information into the computer. See MONITOR.

CURSOR. Usually a blinking indicator on the CRT that shows the user where the next character is to be typed and where it will appear.

DAISY PRINT WHEEL. A printer which has a wheel mechanism, with characters on the perimeter of the wheel. The wheel rotates to place the appropriate character in print position. A "hammer" strikes the character, forcing it against a ribbon, thereby forming an impression on the paper. The daisy wheel printer has the reputation of great reliability, is relatively inexpensive, and forms a solid character on paper.

DATA. The information given to or received from a computer.

DATABASE: Performing a programmed sequence of operations on a body of data to achieve a given result. Also refers to the computer's manipulation of large amounts of data.

DEBUG. Process of finding, locating, and correcting errors in a program that might create problems or provide inaccurate information.

DIAGNOSTIC ROUTINE/PROGRAM. A program that will check out the hardware and peripherals for incorrect information and breakdown.

DIALECTS: Different versions of the same computer language.

DISK (DISC). Magnetic coated material in a 5" or 8" record-like shape on which information and programs are stored. Since the information is stored randomly it can be accessed faster than on cassette storage. Sometimes called diskettes or floppy disks.

DOCUMENT. A written description of a piece of software or hardware. It gives the directions to operate a program or piece of equipment.

DOS. Disk Operating System. A set of programs and instructions that permit interaction between the diskettes and the microcomputer.

EDITOR. A program that allows changing, modification, or movement of programming statements. It allows the programmer to write and modify instructions using the microprocessor and a terminal as a very sophisticated typewriter.

EXECUTE. The running of a computer program.

FLOPPY DISK (DISC) SYSTEM. A device for storing masses of information on a rotating, flexible metallic-coated plastic disk which is similar to a 45 rpm record. Information can be stored and quickly retrieved. Unlike cassette tape, on which all information must be scanned, the disk allows the user to go to any section of the disk without searching through intermediate information.

FORTRAN. Science-oriented program language.

GIGO. Garbage in, garbage out. If incorrect information is put into the computer, the output will be misinformation.

GRAPHICS. Characters used to create figures, shapes, and forms on the CRT or printer.

HARDCOPY. Data or information printed on paper. Used to distinguish between printed information and the temporary image found on the CRT.

HARD DISK DRIVE: A peripheral device for storing programs or other information on disks made of rigid aluminum, coated with a magnetic recording surface. The most common form of storage on large computer systems.

HARDWARE. The physical equipment that goes into a computer system, consisting of the central processing unit plus all peripherals.

INPUT. Information going into the computer or into a peripheral device. The same data may be output from one part of the computer and input to some other part of the computer. When using this word, specify what the data are input to or output from.

INTELLIGENT TERMINAL. Terminal with built-in programmable intelligence enabling it to pre-process information and/or instructions without the aid of a CPU.

INTERFACE. Electronic circuit that connects the CPU and a peripheral device, disk drive, etc., permitting the flow of data back and forth.

INTERPRETER. A program used to translate various computer languages.

I/O. Input/Output of information in a computer system. Examples of I/O devices are: a keyboard, a floppy disk drive, a printer.

KEYBOARD. A device for typing information into a computer. It is similar in design and function to a typewriter keyboard. A computer keyboard has several additional keys for specific computer functions.

LANGUAGE. A format that allows a programmer to communicate more efficiently with a computer where predetermined commands will give requested actions. BASIC is one of the most popular languages. A language is a defined group of representative characters or symbols, combined with specific rules necessary for their interpretation. The rules enable an assembler or compiler to translate the characters into forms (such as digits) meaningful to a machine, system, or a process.

LOAD: To enter a program into the memory of a computer from a peripheral storage device.

LOG IN or LOG ON: A sign-on procedure for users of time-sharing systems.

LOGO: A high-level, interpretive language developed at the Massachusetts Institute of Technology almost 15 years ago.

MEMORY. The integrated circuit of a computer that can execute instructions. It is one component of a microcomputer. It is the brains of the central processing unit (CPU).

MICROCOMPUTER: A computer whose central processing unit is a microprocessor.

MICROPROCESSOR: An integrated circuit that executes instructions. Also, a central processing unit on a single chip. A computer whose main CPU is a microprocessor is called a microcomputer.

MODEM. An abbreviation for "MOdulator-DEModulator." It is a device which permits computers to transmit information over regular telephone lines.

MONITOR. A video display unit which uses a cathode ray tube to generate characters. It looks much like a normal TV set; however, the monitor has a much higher degree of resolution, which permits a clear formation of very small characters on the screen. See CRT (Cathode Ray Tube).

NOISE. Inaccurate data transmission.

OFF-LINE. Refers to data which are stored in devices not immediately accessible to the computer. Data stored on magnetic tape, punched cards, or paper tape must be loaded into on-line storage to be available to the computer.

ON-LINE. Refers to the location of data on storage devices which are immediately accessible to the computer. Usually on-line data are stored on discs, in RAM, or in ROM.

OUTPUT. Information coming from the microcomputer to a display unit, such as a CRT or printer.

PERIPHERAL DEVICE. A device, such as a printer, disk drive, etc., which is an additional computer component.

PERSONAL COMPUTER. A microcomputer designed for instructional uses, entertainment, or personal record-keeping.

PLOTTER. A device that draws on paper two dimensional shapes and designs.

PRINTER. A peripheral device that accepts output data from the microcomputer and prints it on paper. Printers are defined as impact or non-impact. Impact printers strike the paper by a ribbon like a typewriter's. Non-impact printers form characters by electrical charges, or spraying ink.

PROGRAM. A series of instructions to the computer which causes the computer to perform an operation.

PROM: Programmable Read Only Memory. A version of Read Only Memory (ROM) that can be programmed by the user. PROM cannot be changed or erased once it is programmed.

RAM: Random Access Memory. The computer's general purpose memory. RAM may be written into or read from the central processing unit. RAM can be erased and reprogrammed by the programmer as frequently as necessary. It is volatile. That is, it disappears when power to the computer is turned off.

RESPONSE TIME. The time interval required for the m croprocessor to respond to an instruction or input devic

ROM. Read Only Memory. A circuit where data or instru tions are programmed at the time of manufacture. RO cannot be erased during normal operations. ROM is fixe not volatile.

SOFTWARE. Refers to programs and accompanying do umentation. Software is stored on tape cassettes or dis when not being used by the computer. The computer rea the software into its memory in order to use the progran

STORAGE CAPACITY. The quantity of bytes a storage u can hold. It is usually expressed in kilobytes. A diske with 48K (48,000 bytes) for example, has approximat 48,000 characters, letters, numbers, spaces, or symbols

STORE. Placing information in a storage device.

TAPE. The most common microcomputer tape is m netic, such as cassette tape. Magnetic tape is stored electrical charge patterns that are equivalent to what know as letters, numbers, symbols, etc.

TERMINAL. A peripheral device which facilitates hum communication with a computer. Usually it consists o keyboard with alphabetic and numeric characters coup with a printing mechanism or a CRT. One enters inform tion via the keyboard; the computer responds via printer or CRT.

TIMESHARING. The simultaneous use of a central proce ing unit by two or more users, often remote from the C and each other.

TEXT EDITOR: A system of programs which facilitate e ing. The functions available usually consist of adding te deleting text, searching for specified text, paragraphi and page layout.

VIDEO DISPLAY UNIT. A component of a microcompu system which displays the output on a screen similar t TV screen. A television monitor is a type of video disp unit.

Attachment 3