

Approved _____ Date 5-6-92

MINUTES OF THE House COMMITTEE ON Computers, Communications & Technology.

The meeting was called to order by George Dean at _____
Chairperson

7:30 ~~xxx~~ a.m./p.m. on April 8, 1992 in room 529-S of the Capitol.

All members were present except:

Representative Kline - Excused
Representative Patrick - Excused

Committee staff present:

Julian Efird, Research
Donna Stadel, Committee Secretary

Conferees appearing before the committee:

Jim Davis - Post Audit
Barb Hinton - Post Audit
John Roberts - Kansas Lottery

Others attending: See attached list.

Chairman Dean opened the meeting at 7:30 a.m., presenting the minutes of March 19, March 20, and March 23, for review.

Mr. Jim Davis from Post Audit appeared before the committee to respond to legislative concerns regarding the Lottery's proposed acquisition of new computer software and hardware after conducting a 100-hour audit (attachment 1).

Considerable discussion followed Mr. Davis' review of the audit regarding examining the Kansas Lottery's plans for acquiring new computer software and hardware (attachment 2).

He also reviewed the audit report concerning capacity and use of the State's mainframe computers (attachment 3).

Chairman Dean stated it was his understanding the Lottery's goal is to have the option of adding more games and a financial package wrapped up into one computer. The problem existing today being their present computer will not run more than ten games, and this was only accomplished by making their own adjustments to the system.

Mr. Davis said he believed this was true, and also pointed out the Lottery's present operating system will no longer be supported by the vendor after mid '93. This poses a time problem. He would like to have seen a more independent assessment of their current operations and needs, without so much Anderson involvement at that point. Not that Anderson may not be the right answer, but it is more difficult to feel confident in that answer, given the way the needs assessment was done.

Discussion followed concerning findings from other audits previously done, and complexities involved for agencies to determine and establish specifications. Mr. Davis replied he thought it was very difficult and was a real problem. He offered

CONTINUATION SHEET

MINUTES OF THE House COMMITTEE ON Computers, Communications & Technology
room 529-S, Statehouse, at 7:30 a.m./~~p.m.~~ on April 8, 1992

an option that if they contract out with an independent consulting firm, to perhaps use one who doesn't have a product for this particular area. Also, it could be helpful if agencies would, in general, rely on DISC for this kind of expertise at the planning stage. It is not unusual for agencies to have more computing needs than they have in-house expertise, who could plan and write specifications for them. This is where DISC could do a better job of utilizing their expertise.

Barb Hinton offered that an oversight phase might be warranted, when utilizing contract work, where a separate entity like DISC be responsible for an independent review of the final product to ensure that the kinds of things needed to be considered, were in fact, considered and a good assessment of the agency needs and work done was in compliance with an overall system objective.

Chairman Dean summarized by saying he felt they have touched on what he believes are some important points, and which has been a general problem throughout the governmental system. It appears each department is generating their own computer system, rather than all being brought together under one mainframe. Perhaps the determining factor hinges on how much database one has to share with another department, whether you need your own system or the mainframe. He felt like perhaps, they were beginning to get a handle on this, or at least see where the handle is.

Discussion followed concerning the pro's and con's of DISC being involved as described above. It probably would be difficult for DISC to operate within the current system by being placed in the position to enforce, but not having the power to do so.

Mr. John Roberts, Director of Administration, appeared before the committee to clarify points made in the Lottery report. He commended Mr. Davis and Mr. Reeves for the large task they had before them in understanding the environment in which the Lottery operates and their data processing needs.

Rep. McKechnie moved the minutes from the meetings of March 19, 20, and 23, be approved. Seconded by Rep. Mead. Motion carried.

Chairman Dean announced the committee would have one more meeting to be announced before the end of the session. With no further business, the meeting was adjourned until further notice.

PRESENTATION
To the House Committee on
Computers, Communications & Technology

**Examining the Kansas Lottery's Plans for Acquiring New
Computer Software and Hardware**

To respond to Legislative concerns about the Lottery's proposed acquisition of new computer software and hardware, we conducted this 100-hour audit addressing the following question:

Has the Kansas Lottery adequately planned for its computer software and hardware needs?

To answer this question, we looked at various "systems design methodologies" to see what steps generally are included in a needs assessment. The initial steps are summarized on pages 7-8 of the report.

- The first step is a systematic review of current agency operations.
- Next, is an assessment of the current system's limitations and problems, and of the agency's unmet needs.
- Third is a review of the conceptual alternatives for addressing the limitations, problems, and unmet needs.
- Fourth is a review of the variables that might affect costs and schedules.
- And, Finally, estimates of the probable costs and benefits of a new system.

Depending on the size and scope of the project, these steps may be done in-house or contracted out. In addition, in a government setting, an agency might seek planning moneys from the Legislature before seeking funding for the new software or hardware itself.

After Legislative approval for a new system has been received, an agency would take additional steps. These additional steps are shown in the box on page 8 of our report.

We found that the Lottery had done what appeared to be a thorough review of the problems and limitations with its current system. However, most of the formal, systematic review we saw of the Lottery's current operations and its computing needs was done by Andersen Consulting, and was specific to Andersen's own ACCLAIMS software package. Andersen officials we spoke with called what they did a review of the Lottery's business requirements so that they could perform a "fit analysis" to show how their ACCLAIMS package would work for the Lottery.

Whether the review of an agency's operations and computing needs is conducted in-house or is contracted out, this step generally should not be product-specific. Such a review should produce an independent assessment from which an agency can determine an appropriate course of action. Generally, we found the Lottery's needs assessment, as performed by Andersen Consulting, was not independent.

ACCLAIMS may well be the system that best serves the Lottery's needs; it is

being used by a number of other state lotteries. But because the needs assessment for this project was apparently done solely with respect to what ACCLAIMS had to offer, there is much less assurance that the Lottery's true needs were evaluated. A more independent assessment would have given the Lottery a better basis for evaluating different products and other potential alternatives.

We also found that the Lottery did not adequately consider variables that could affect costs, schedules, and probable benefits of its proposed new system before it submitted its fiscal year 1993 budget request. Our concerns in this area are set out in the report on pages 11-12.

One of the items we cited was that...

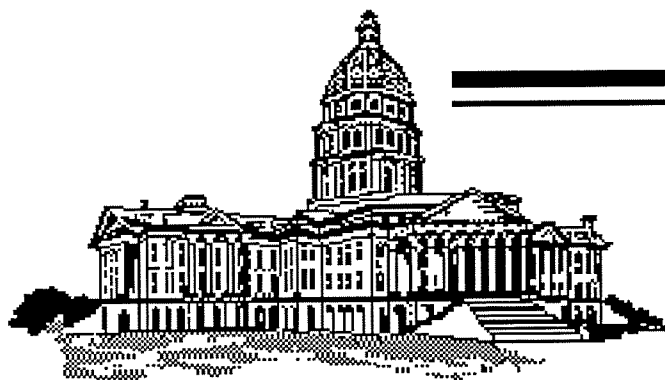
The Lottery could be overestimating how much work its own staff could perform on the project (#2 on p. 11 of our report). In its report to this (House CCT) Committee, the Lottery stated that no additional in-house personnel would be needed to convert to and operate the new system, but that "during the conversion process the current technical support staff will divert their energies from maintaining LottoSTARTS to working with Andersen staff...It is estimated that over 2,000 person-hours of time will be dedicated by the data processing staff during this six-month full implementation schedule." The Lottery did not assign a projected staff cost to this figure.

The Lottery's 2,000-hour estimate assumes that two employees would work full-time for six months during the conversion process. The Lottery currently has only five technical support staff maintaining and operating the LottoSTARTS system. It would seem logical that until the new system was fully operational, these employees could have significant responsibilities continuing to operate and maintain the old one.

Another area of concern was that...

Some of the assumptions behind the Lottery's cost/benefit analysis for the new computer system could be misleading (#4 from p. 12 of our report). In its report to the this (CCT) Committee, the Lottery presented a table to show purported annual cost savings associated with ACCLAIMS of about \$200,000 per year. In its analysis, the Lottery showed that such savings would be achieved by buying twice as many tickets per game and receiving a volume discount. It also assumed that the Lottery would sell essentially all those additional tickets. However, we would point out that neither assumption is related to acquiring ACCLAIMS. The Lottery could have achieved those "savings" with its existing system.

Since 1987, our office has conducted five audits of State agency computer acquisition or development projects. Those audits have shown that State agencies: 1) generally did not adequately plan or manage their computer projects; 2) consistently underestimated how long the projects would take and what they would cost; and 3) consistently overestimated how much of the work could be handled by in-house staff. We have no way of knowing whether the Lottery would experience similar problems with its proposed project, but we think a careful review of the assumptions and analyses regarding estimated project costs, schedules, and benefits is warranted to help minimize potential future problems or misunderstandings.



PERFORMANCE AUDIT REPORT

Examining the Kansas Lottery's Plans for Acquiring New Computer Software and Hardware

A Report to the Legislative Post Audit Committee
By the Legislative Division of Post Audit
State of Kansas
April 1992

92-45

*CCT Committee
Attachment 2
4-8-92*

Legislative Post Audit Committee

Legislative Division of Post Audit

THE LEGISLATIVE POST Audit Committee and its audit agency, the Legislative Division of Post Audit, are the audit arm of Kansas government. The programs and activities of State government now cost about \$6 billion a year. As legislators and administrators try increasingly to allocate tax dollars effectively and make government work more efficiently, they need information to evaluate the work of governmental agencies. The audit work performed by Legislative Post Audit helps provide that information.

We conduct our audit work in accordance with applicable government auditing standards set forth by the U.S. General Accounting Office. These standards pertain to the auditor's professional qualifications, the quality of the audit work, and the characteristics of professional and meaningful reports. The standards also have been endorsed by the American Institute of Certified Public Accountants and adopted by the Legislative Post Audit Committee.

The Legislative Post Audit Committee is a bipartisan committee comprising five senators and five representatives. Of the Senate members, three are appointed by the President of the Senate and two are appointed by the Senate Minority Leader. Of the Representatives, three are appointed by the Speaker of the House and two are appointed by the Minority Leader.

Audits are performed at the direction of the Legislative Post Audit Committee. Legislators or

committees should make their requests for performance audits through the Chairman or any other member of the Committee. Copies of all completed performance audits are available from the Division's office.

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LEGISLATIVE DIVISION OF POST AUDIT

1200 Merchants Bank Tower
8th & Jackson
Topeka, Kansas 66612-2212
Telephone (913) 296-3792
FAX (913) 296-4482

PERFORMANCE AUDIT REPORT

EXAMINING THE KANSAS LOTTERY'S PLANS FOR ACQUIRING NEW COMPUTER SOFTWARE AND HARDWARE

OBTAINING AUDIT INFORMATION

This 100-hour audit was conducted by Jim Davis, Senior Auditor, and Randall Reeves, Auditor, of the Division's staff. If you need any additional information about the audit's findings, please contact Mr. Davis at the Division's office.

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EXAMINING THE KANSAS LOTTERY'S PLANS FOR ACQUIRING NEW COMPUTER SOFTWARE AND HARDWARE

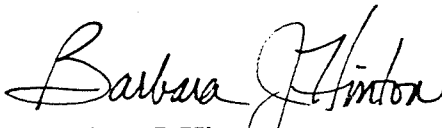
Summary of Legislative Post Audit's Findings

The Lottery recommended in March 1991 that its existing instant game software and hardware be replaced. Its fiscal year 1993 budget request included \$930,000 for a new computer system, and that amount has since been increased to just over \$1.4 million. In late February 1992, the Senate Ways and Means Committee deleted the Lottery's funding request because it was not convinced the Lottery had completed a sufficient needs analysis, and thought the Lottery had "preselected" a particular vendor's software that would not run on the agency's existing computer systems. That Committee requested the House Committee on Computers, Communication and Technology to study the proposed acquisition and to report its findings before the end of the 1992 legislative session. To address these concerns, the House Committee requested, and the Chair of the Legislative Post Audit Committee directed, a 100-hour audit to answer the following question:

Has the Kansas Lottery adequately planned for its computer software and hardware needs? Generally, an adequate needs assessment begins with an examination of current operations, an evaluation of existing problems and unmet needs, and a review of alternatives and costs. The Lottery prepared a number of reports regarding its request for new computer software and hardware. However, officials could produce very little documentation to support the planning and analyses that may have been done to prepare those reports. Most of the formal systematic review we saw of the Lottery's current operations and its computing needs was done by Andersen Consulting, and was specific to Andersen's own ACCLAIMS software package.

The Lottery did not adequately consider variables that could affect costs, schedules, and probable benefits of its proposed new system before it submitted its fiscal year 1993 budget request. We have conducted five audits since 1987 that have shown that State agencies generally did not adequately plan or manage their computer projects, consistently underestimated how long the projects would take and what they would cost, and consistently overestimated how much of the work could be handled by in-house staff. We have no way of knowing whether the Lottery would experience similar problems with its proposed project, but we think a careful review of the assumptions and analyses regarding estimated project costs, schedules, and benefits is warranted to help minimize potential future problems or misunderstandings.

We would be happy to discuss the findings presented in this report with any legislative committees, individual legislators, or other State officials.


Barbara J. Hinton
Legislative Post Auditor

Examining the Kansas Lottery's Plans for Acquiring New Computer Software and Hardware

For fiscal year 1993, the Kansas Lottery has requested about \$1.4 million to purchase new lottery software for instant lottery games that was developed and marketed by Andersen Consulting, and two IBM AS/400 computers to run it on. In testimony before the House Committee on Computers, Communications, and Technology, Lottery officials said the current software no longer had vendor support for problems or needed revisions, and the existing computer would no longer have vendor support after July 1993 because the computer technology was more than 10 years old.

Lottery officials also noted that Kansas was the only state that uses the current software, and that six other lotteries use the new software they want to buy. They pointed out that the new software would allow the Lottery to operate nearly 100 games at one time, so games could be continued until the tickets were sold out. (Few lottery games can be operated under the current software, and when new games are added, old ones must be stopped and the tickets destroyed.) Finally, they indicated that the new software could be modified to help provide an integrated financial ledger system to help meet the Lottery's financial reporting needs.

In late February 1992, the Senate Ways and Means Committee deleted the Lottery's funding request because, according to a memorandum from the Legislative Research Department, it was not convinced the Lottery had completed a sufficient needs analysis, and thought the Lottery had "preselected" a particular vendor's software that would not run on the agency's existing computer systems.

The Committee asked the Division of Information Systems and Communications and the Legislative Post Audit Committee to review these matters. It also requested the House Committee on Computers, Communications and Technology to study the proposed acquisition and to report its findings before the end of the 1992 session. The House Committee requested, and the Chair of the Legislative Post Audit Committee directed, the Legislative Division of Post Audit to conduct a 100-hour audit to answer the following question:

Has the Kansas Lottery adequately planned for its computer software and hardware needs?

To answer this question, we reviewed State statutes and interviewed officials with the Kansas Lottery, the Division of Information Systems and Communications, and Andersen Consulting. In addition, we reviewed previous audit work concerning State agency computer system acquisitions, as well as literature describing the steps that should

be taken in developing or acquiring computer software. In conducting this audit, we followed all applicable government auditing standards set forth by the U.S. General Accounting Office.

In general, we found that the Lottery could produce very little documentation to support the planning and analyses it may have performed. In addition, most of the needs assessment for this proposal was performed by Andersen Consulting and was specific to Andersen's own software package. Although the Lottery considered a number of conceptual alternatives, it apparently did not formally consider other prepackaged software until after it submitted its fiscal year 1993 budget request. Finally, we found that the Lottery's proposed software and hardware acquisition merits careful review in a number of key areas addressed in previous audits of recent State agency computer acquisition or development projects. These and other findings will be discussed following an overview of the Lottery's current and proposed computer systems.

An Overview of the Kansas Lottery's Current and Proposed Computer Systems

The Lottery Purchased Its Current Computer Software And Hardware in Mid-1987

In June 1987, the Kansas Lottery awarded a \$900,000 contract for computer software and hardware to operate its instant ticket games to British American Bank Note Corporation, a Canadian firm that had submitted the lowest-cost proposal. (By the end of June 1988, the contract had been amended several times and the Lottery had spent a total of \$1.6 million on computer hardware, software, and consulting services. Much of the increase was attributed to the unanticipated start of on-line games that year, and to staffing shortages in the Lottery.)

The selection of British American Bank Note Corporation was recommended by a procurement negotiating committee consisting of the Lottery's Executive Director, the Chair of the Lottery Commission, and the Director of Purchases, even though the Corporation had never developed or installed instant ticket software before. State law establishing the Lottery exempted the Lottery Director from obtaining approval from the Divisions of Purchases and Information Systems and Communications before acquiring computer hardware or software.

The software the Corporation subsequently developed was called LottoSTARTS, which was written for a Tandem computer. The computer hardware was delivered in August 1987, and the software systems were installed in September and October. Ticket sales for the first instant game started in early November 1987. During its start-up phase, the Lottery also acquired an IBM System 36 computer to handle its information management functions, such as the retailer licensing process, word processing, and office automation.

By early 1988, Lottery personnel concluded that the software was not performing as well as expected. As noted in our 1988 audit, Kansas Lottery: Reviewing Vendor Contracts and Financial Management and Accounting Practices, Lottery officials identified the following types of contract deficiencies: inadequate training, user manuals that were not up-to-date, the need to streamline the ticket validation software to prevent duplicative data entry and to provide increased security over validations and prize payments, and the need for better information to help monitor sales and identify marketing strategies.

Beginning in March 1988, Lottery staff met with officials from British American Bank Note Corporation to try to resolve these differences. The Corporation agreed to

address most problems at no additional cost, and to pay for \$6,000 of an estimated \$12,000 in additional training costs, with the Lottery picking up the balance. The modifications were to be delivered by October 1988. At the time of our previous audit, Lottery officials told us that the problems encountered with this contract did not have a significant impact.

By March 1991, the Lottery Was Recommending That Its Existing Computer Software and Hardware Be Replaced

A March 1991 memo from the Lottery's then-Deputy Director to the Division of the Budget pointed out a number of problems with the Lottery's computer software and hardware. These problems included the following:

- Kansas is the only State using LottoSTARTS software, and the Corporation no longer markets or supports LottoSTARTS or any other lottery software.
- LottoSTARTS is not fully integrated with the agency's other business functions, such as a general financial ledger system.
- the LottoSTARTS software is very poorly documented, making programming changes extremely difficult
- minor programming changes to the software can cause unexpected and unanticipated results, and take an "exorbitant" amount of time to resolve
- the Tandem computer is expensive and difficult to maintain

Because of these problems, the Lottery indicated in that memo that it had explored a number of options, including rewriting and customizing the LottoSTARTS software in-house, buying and installing instant game software being developed by the Washington State Lottery for its Tandem computer, and replacing the LottoSTARTS with other "packaged" software.

The Lottery projected that rewriting the software in-house would take five years and require six additional employees. It also dismissed the option of buying the Washington Lottery's software package because that software did not include a general ledger system, was not expected to be completed until January 1992 at the earliest, and would not be supported by Washington Lottery officials.

The Lottery proposed that the option of replacing LottoSTARTS with the ACCLAIMS software package developed and marketed by Andersen Consulting would resolve its current problems and address its long-term needs. The ACCLAIMS software included a general ledger system and was designed to operate on an IBM AS/400 computer. The Lottery recommended to the Division of the Budget that it purchase the ACCLAIMS software package and the new computer hardware. It estimated the cost at \$1.5-\$2.0 million.

In April 1991, the Lottery's Budget Request Was Amended To Include at Least \$1.4 Million for a New Computer System

In the Governor's Budget Amendment No. 2 (April 18, 1991), addressed to the 1991 Legislature, the Governor recommended expenditures of \$100,000 for fiscal year 1991, \$125,000 for fiscal year 1992, and a fiscal year 1993 payment that would range from about \$1.2 million to \$1.7 million to purchase the new computer system. Over the three-year period, then, the amount to be spent was estimated at \$1.4-\$1.9 million.

The 1991 Legislature prohibited the Lottery from acquiring any new computer equipment and software in fiscal years 1991 or 1992. It directed the Lottery to submit its request to the 1992 Legislature as part of its budget request so that the Legislature could adequately review the proposed acquisition.

The Lottery's Budget Request for Fiscal Year 1993 Included \$930,000 for a New Computer System

The Lottery's fiscal year 1993 budget request included moneys to replace its Tandem and IBM System 36 computers and LottoSTARTS software with the ACCLAIMS software and two AS/400 computers. (A larger AS/400 model would be used to run the software, while a smaller one would be used for word processing, testing, an internal control system, and back-up. Both machines would be linked so that data could transfer between them.)

The new system the Lottery proposed would include the following:

Cost of ACCLAIMS Software	\$ 380,000
Cost of Software Installation	400,000
Cost of Hardware Configuration	250,000
Anticipated Trade-In Value	<u>(100,000)</u>
TOTAL	\$ 930,000

The Senate Ways and Means Committee deleted the \$930,000 pending further legislative review of this proposal by the Division of Information Systems and Communications and the House Committee on Computers, Communications and Technology.

In response to the House Committee's request for information about the planning and needs analysis the Lottery had performed for this project, Lottery officials prepared a report with the assistance of the Division of Information Systems and Communications, and in accordance with the Division's "data processing acquisition justification guide-

**A Previous Audit Noted Problems
With the Lottery's Lack of
Integrated Financial Information**

As part of its justification for a new computer system, the Lottery said "the Legislative Post Audit Committee recommended that the Lottery explore the possibility of software enhancements and modifications to allow the installation of a fully integrated general ledger package to work with LottoSTARTS on the Tandem." A June 1989 Financial-Compliance Audit Report pointed out that the Lottery's financial systems were not fully integrated, which resulted in weaknesses in reconciliation between those various information systems. The audit noted that a fully integrated system would automatically tie this information together. It would also provide for timely and accurate management information and reduce the overall cost of information processing and reporting.

lines." (Officials with the Division of Information Systems and Communications said that they had little contact with the Lottery about the proposed acquisition before this time.) This report primarily explains the Lottery's current situation, summarizes its acquisition proposal, provides a detailed cost review, and discusses implementation issues and costs.

**The Lottery Has Since Increased Its
Estimated Cost for the New Computer
System to More Than \$1.4 Million**

In the report it prepared for the House Committee on Computers, Communication and Technology, the Lottery revised its cost

estimates upwards for the computer software and hardware systems by about \$500,000. Those revised cost estimates are as follows:

Cost of ACCLAIMS Software	\$ 460,000
One-time Systems Software Charges	80,227
Cost of Software Installation	400,000
Cost of Hardware Configuration	336,899
Consultants' Out-of-Pocket Expenses	97,200
Five-Year Equipment Warranty	<u>52,000</u>
TOTAL	\$ 1,426,326

As the table shows, estimated costs for the software and hardware were increased by about \$80,000 each, and additional expenses related to one-time costs, out-of-pocket expenses, and equipment warranty were included. Lottery officials stated that the \$1.4 million represented a maximum, and that they expected the costs would actually be somewhat lower by negotiating with the vendor for the software and obtaining hardware through a competitive bid process.

Has the Kansas Lottery Adequately Assessed Its Computer Software and Hardware Needs?

In general, an adequate needs assessment begins with an examination of current operations, an evaluation of existing problems and unmet needs, and a review of alternatives and costs. The Lottery could produce very little documentation to support the planning and analyses it may have performed. Most of the needs assessment for this proposal was performed by Andersen Consulting, and was specific to Andersen's own software package. Although the Lottery considered a number of conceptual alternatives, it apparently did not formally consider other prepackaged software until after it submitted its fiscal year 1993 budget request. And finally, the Lottery's proposed software and hardware acquisition merits careful review in a number of key areas addressed in previous audits of recent State agency computer acquisition or development projects.

In General, an Adequate Needs Assessment Begins With an Examination of Current Operations, an evaluation of Existing Problems and Unmet Needs, and a Review of Alternatives and Costs

To determine the elements included in a needs assessment, we looked at a number of "systems design methodologies." (Because computer systems are so complex, a systems design methodology is generally used to systematically organize the process of acquisition or development.) Although the various methodologies we looked at used somewhat different terms, they generally contained the same basic components. Those basic components included:

- **a review of current operations**—a systematic examination of current agency procedures, business practices, computer processes, data flows, and the like
- **an assessment of the current system's limitations and problems, and of the agency's unmet needs**—includes input from users and management to find out what does not work, does not work well, or does not meet the agency's objectives or goals, and what the agency needs to allow it to do whatever it does better
- **a review of the conceptual alternatives for addressing problems and meeting needs**—a high-level assessment of possible solutions (for example, consideration of the best approach to address problems and meeting needs by revising what the agency has through manual adjustments, developing a new system in-house, or acquiring prepackaged software)
- **a review of the variables that might affect costs and schedules**—for example, staffing required to develop, convert to, and operate a new system, additional staff training, whether outside consultants might be needed, equipment and space considerations, whether prepackaged software is available, and if so, what modifications would likely be needed

- **probable costs and benefits of a new system**—estimates of what a new system would cost and the benefits a new system would provide based on the steps done to this point, and on additional information from such sources as internal data processing staff, the Division of Information Systems and Communications, other states, and potential vendors

Depending on the size and scope of the project, the steps through this point may be done in-house (with or without the assistance of the Division of Information Systems and Communications) or contracted out. In addition, in a government setting, an agency may have sought planning moneys from the Legislature before seeking funding for software and hardware acquisitions.

Whether or not an agency has requested planning moneys, at this stage it would have made a decision as to how it wanted to proceed, and would be prepared to bring its plans to the Legislature to be funded through the budget and appropriations process. The steps an agency would follow after it has received Legislative approval are described in the accompanying box.

**Planning Steps To Be Followed
After the Agency Receives Legislative Approval**

Once it has received Legislative approval for a proposed project, an agency would be expected to follow a number of additional steps. These steps are as follows:

- **conduct a system requirements definition**—a thorough analysis of current operations, reports used, and work processes, as well as an assessment of user problems, objectives, and requirements for a proposed system. In a sense, a systems requirements definition is a more in-depth version of analyses already performed in the needs assessment described in this report. In many cases, an outside consultant may be hired to perform this step.
- **prepare detailed specifications**—the end result would be a request for proposals to be sent to potential vendors, unless the proposed system is available from only one source.
- **receive proposals and compare them with the agency's identified needs for its new system**—unless such system is to be acquired on a sole source basis (in which case, negotiations would be conducted with the vendor).
- **make a selection**—as a part of making its selection, the agency would need to work out specific details of the modifications necessary to make the proposed system conform to the agency's needs (for example, the reports to be produced, what elements those reports should contain, and even what the reports should look like).

To determine whether the Lottery adequately assessed its computer software and hardware needs, we reviewed reports, interviewed Lottery officials, and asked for and reviewed copies of any and all documentation Lottery officials could provide in support

of their planning effort. We compared what we found with the basic components of a needs assessment identified above. The results of our review are presented in the following sections.

The Lottery Could Produce Very Little Documentation To Support the Planning and Analyses It May Have Performed

A systematic needs assessment for computer systems generally results in a number of written memos or reports summarizing the outcome of that assessment and recommending a course of action. Such reports should be supported by documentation of the reviews, interviews, comparisons, and other analyses an agency may have performed during the needs assessment.

The Lottery did prepare a number of reports regarding its request for new computer software and hardware. In addition, in a March 1991 memo to the Division of the Budget, Lottery officials said they had gathered a "vast amount of information" concerning the various computer system options discussed in that memo. Based on that assertion, we expected to see considerable supporting documentation describing the Lottery's current operations, detailing the problems and limitations with the existing system, identifying unmet needs, and showing analyses of different options and costs.

Despite its assertion, the Lottery was able to produce little documentation to support the work it had done during the needs assessment. Lottery officials were able to provide some documentation concerning limitations and problems with the existing system. Nothing they produced appeared to be a systematic examination of the Lottery's current operations. Lottery officials indicated that there has been considerable turnover in the Lottery staff involved with this project, which likely contributed to the lack of available documentation.

Most of the Needs Assessment for this Proposal Was Performed By Andersen Consulting, and Was Specific to Andersen's Own ACCLAIMS Software

Whether the review of an agency's operations and computing needs is conducted in-house or contracted out, this step generally is not product-specific unless the agency was upgrading its current system or found that the desired system was available from only one source. Such a review should help provide an independent assessment from which the agency can determine an appropriate course of action.

Generally, the Lottery's needs assessment was specific to the ACCLAIMS software, and was not conducted independently. The only systematic review we saw of the Lottery's current operations and its computing needs was done by Andersen Consulting. This review was performed without charge.

According to Lottery officials, the former Deputy Director obtained promotional information about the ACCLAIMS package and contacted Andersen Consulting in 1990 to find out more about it. In addition, ACCLAIMS apparently also was recommended to Lottery officials by the firm conducting the Lottery's financial audit—Arthur Andersen and Company. Arthur Andersen and Company and Andersen Consulting are separate, but related entities.

An official with Andersen Consulting stated that individuals with his firm met with Lottery staff several times in 1990. Andersen staff spent about a week on-site at the Lottery meeting with the previous deputy director, director of administration, and data processing chief, as well as programmers and accounting staff, to ascertain the Lottery's business requirements and conduct a "fit analysis." Such a fit analysis was Andersen's process of matching the features of its system—ACCLAIMS—with what it determined the Lottery's needs to be.

The end result was a January 1991 preliminary proposal by Andersen Consulting to sell the ACCLAIMS package to the Lottery. This preliminary proposal was the basis of the Lottery's proposal and cost estimates in its March 1991 memo to the Division of Budget, and the budget amendment submitted to the 1991 Legislature.

Although the Lottery is not required to obtain the Division of Information Systems and Communications' approval for its computer acquisitions, it did submit an Information Management Plan to the Division. It also prepared a report for the House Committee on Computers, Communication, and Technology in accordance with the Division's "data processing acquisition justification guidelines." While the Division officials we talked with said they considered the report to be a sufficient justification for the proposed acquisition, they indicated they had not reviewed the information Andersen Consulting prepared.

Although the Lottery Considered a Number of Conceptual Alternatives, It Apparently Did Not Formally Consider Other Packaged Software Until After It Submitted Its Fiscal Year 1993 Budget Request

In its March 1991 memo to the Division of Budget, the Lottery discussed several different options for addressing its computer needs, including rewriting the existing software in-house, purchasing another state's software package, and acquiring a prepackaged software system.

The Lottery eliminated all options except acquiring prepackaged software, and appeared to focus exclusively on Andersen Consulting's ACCLAIMS package. Apparently, one reason for this decision was that the ACCLAIMS package has been used by several other states in establishing their lotteries.

Lottery officials said they had explored another prepackaged system marketed by Game Plan International, but had dismissed it as an unsatisfactory alternative because it had no general ledger package and was so new that it had no proven track record. We saw documentation indicating that Game Plan officials performed an on-site demonstration of their lottery management system in December 1991. In the report the Lottery prepared for the House Committee on Computers, Communication and Technology in March 1992, Lottery officials mentioned the Game Plan alternative, but stated it was more expensive and less comprehensive than the ACCLAIMS package.

In that same March 1992 report, the Lottery also indicated that its current Tandem computer's operating software would no longer receive vendor maintenance support after July 1993. Tandem officials told us that the Lottery's system could be supported if it upgraded its hardware to accommodate Tandem's newer operating software. Tandem officials also told us that they were in the process of putting together a proposal for the Lottery for the cost of such upgrades.

The Lottery Did Not Adequately Consider Variables That Could Affect Costs, Schedules, and Probable Benefits of Its Proposed New System Before It Submitted Its Fiscal Year 1993 Budget Request

In reviewing the report the Lottery prepared for the House Committee on Computers, Communications and Technology, we noted a number of comments or analyses that raised concerns about the adequacy of the Lottery's assessments in these areas. Our concerns were as follows:

1. *The completion time for this project could be underestimated.* Andersen Consulting apparently has projected that its ACCLAIMS software could be installed and fully operational in Kansas within six months. The Lottery refers to this estimate as an "aggressive" time schedule that is consistent with other states' experiences and with the firm's preliminary work with the Lottery. According to the Lottery's report, "a detailed implementation schedule, specific to the Kansas Lottery, would need to be jointly developed between Andersen Consulting, DISC, and the Kansas Lottery."
2. *The Lottery could be overestimating how much work its own staff could perform on the project.* In its report, the Lottery states that no additional in-house personnel would be needed to convert to and operate the new system, but that "during the conversion process the current technical support staff will divert their energies from maintaining LottoSTARTS to working with Andersen staff....It is estimated that over 2,000 person-hours of time will be dedicated by the data processing staff during this six-month full implementation schedule." The Lottery did not assign a projected staff cost to this figure.

The Lottery's 2,000-hour estimate assumes that two employees would work full-time for six months during the conversion process. It currently has only five technical support staff maintaining and operating the LottoSTARTS system on the Tandem computer. It would seem logical that until the new system was fully operational, these employees could have significant responsibilities continuing to operate and maintain the old one.

3. *The Lottery significantly underestimated the cost of the project in its budget request for fiscal year 1993.* As noted in the overview section, although the new computer system initially was projected to cost \$1.5-\$2.0 million, the Lottery's fiscal year 1993 budget request asked for only \$930,000. Following its review of information for the House Committee on Computers, Communications and Technology, the Lottery subsequently raised the estimated cost to more than \$1.4 million.
4. *Some of the assumptions behind the Lottery's cost/benefit analysis for the new computer system could be misleading.* In its report to the House Committee, the Lottery presented a table to show purported annual cost savings associated with ACCLAIMS of about \$200,000 per year. In its analysis, the Lottery showed that such savings would be achieved by buying twice as many tickets per game and receiving a volume discount. It also assumed that the Lottery would sell essentially all those additional tickets. However, we would point out that neither assumption is related to acquiring ACCLAIMS. The Lottery could have achieved those "savings" under its existing system.

We also questioned the Lottery's assumption in a later section of its report that it would end up destroying 3.5 percent of the tickets purchased whether it bought 3.7 million tickets or 7.5 million tickets. Finally, we noted that the Lottery incorrectly computed the savings figure it reported under the ACCLAIMS system for destroying or "shredding" unused tickets.

We thought it important to bring these concerns to the Lottery's and the Legislature's attention because of problems we have identified in five other audits that examined various aspects of State agencies' acquisition or development of major computer systems. Those audits showed that State agencies generally:

- did not adequately plan or manage their computer projects
- consistently underestimated how long it would take to complete a project and how much work was involved
- consistently overestimated how much work could be handled by in-house staff
- consistently underestimated the cost of the completed project

We have no way of knowing whether the Lottery's estimates and assumptions will hold true. However, because so many agencies have experienced problems in these areas, we think a careful review of the assumptions and analyses regarding project costs, schedules, and benefits is warranted to help minimize potential future problems or misunderstandings.

Conclusion

We saw considerable evidence that the Lottery's current system is lacking in a number of ways, and that the Lottery will have to take some sort of action in the relatively near future. Lottery officials appear to have eliminated the least practical alternatives, such as an in-house rewrite of their current software programs. But it was difficult to tell whether they have adequately explored other alternatives—however limited—besides the ACCLAIMS package offered by Andersen Consulting. For example, we saw no documentation that Lottery officials seriously considered upgrading their existing Tandem computer's operating system and continuing to operate the LottoSTARTS software. In addition, we saw no evidence that the Game Plan software received the same level of consideration as the ACCLAIMS software.

ACCLAIMS may well be the system that best serves the Lottery's needs; it is being used by a number of other state lotteries. But because the needs assessment for this project apparently was done solely with respect to what ACCLAIMS had to offer, there is much less assurance that the Lottery's true needs were evaluated. A more independent assessment would have given the Lottery a basis for evaluating how well different products or alternatives met its needs.

APPENDIX A

Agency Response

On March 31, 1992, we provided copies of the draft audit report to the Kansas Lottery. Their response is included as this Appendix.

Joan Finney
Governor



Kansas Lottery

Ralph W. E. Decker
Executive Director

April 3, 1992

Barbara Hinton
Legislative Post Audit
800 Jackson Suite 1200
Topeka, KS 66612-2212

Dear Ms. Hinton:

We have completed our review of the Legislative Post Audit report, reviewing the Kansas Lottery's Plans for Acquiring New Computer Software and Hardware. We appreciate the difficult task facing your staff in reviewing all the documentation involved in this project within the very short time frame afforded them. The Lottery responds as follows.

Post Audit concluded that there is, 1) considerable evidence that the Lottery's current system is lacking in a number of ways; 2) the Lottery will have to take some action in the relatively near future; and 3) an in-house rewrite of current software is the least practical alternative. Also Post Audit states that the Lottery did not seriously consider upgrading its existing Tandem computer operating system. This has been covered both in our documents and in our meetings with Post Audit but will be repeated here. Upgrading the existing Tandem system would not resolve the software problem and would result in moneys being spent (approximately \$180,000) on equipment that would be replaced when the software problems are resolved. It was for this financial reason that the Lottery did not seriously consider this option. Upgrading the Tandem system would not resolve the problems being addressed by the Lottery's funding request. Post Audit also concluded that there was "no evidence the Game Plan software received the same level of consideration as the ACCLAIMS software." Two internal reports generated by Lottery data processing staff were supplied to Post Audit staff comparing three available options to the Lottery. The options were 1) rewrite the existing software, 2) acquiring Game Plan, and 3) acquiring ACCLAIMS. Game Plan was indeed reviewed and was found to be lacking financial reporting capabilities and word processing capabilities, both significant features in the Lottery's view. This coupled with Game Plan's much higher price and significant shortcomings and short track record made Game Plan a less attractive alternative. The Post Audit report states that the Division of Information Systems and Communications (DISC) told Post Audit that they considered the Lottery's DISC 3608 Guidelines Report to be "sufficient justification for the acquisition". The

Barbara Hinton
April 3, 1992
Page 2

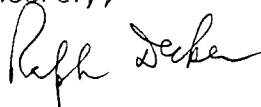
Lottery understands that DISC is the state agency that has been directed by the Legislature to oversee state agency requests for computer hardware and software acquisition.

Post Audit's conclusion also states that a more independent assessment would have given the Lottery a basis for evaluating how well different products or alternatives met its needs. Lottery officials told Post Audit that such an independent evaluation would cost a minimum of \$40,000 and had been deemed unnecessary based on conversations with DISC. Lottery officials also told Post Audit that the Lottery was more than willing to put both software and hardware out for bid via the R.F.P. process if that procedure was deemed prudent by Post Audit, the Computers, Communications and Technology committee and the Legislature.

Post Audit has been informed by Lottery officials that its choice of prepackaged software is extremely limited. Currently, only Game Plan and ACCLAIMS are available as prepackaged software for state lotteries. Game Plan has recently been acquired by GTECH, the Lottery's on-line games vendor. It is not known at the time of this writing what impact this acquisition will have on Game Plan's price or possible upgrades to its software.

The Lottery feels that it has conducted a sufficient needs analysis for its proposed acquisition of new computer hardware and software. The Lottery is also more than willing to take whatever route deemed necessary by the Legislature in order to secure funding for this acquisition. If funding is not approved this legislative session it would be a minimum of 21 months before a new computer system could be purchased and installed by the Lottery. This approximately two year wait could have a dramatic impact on the Lottery's ability to efficiently generate revenue for the state of Kansas. The Lottery feels that it has conducted an independent and thorough assessment of its needs and requirements with regards to a new computer system. Based on the Post Audit report it appears that the Lottery is being asked to meet standards that Legislative Post Audit is unable to clearly define. This is not meant as a repudiation of the Post Audit report but rather a request by the Lottery for clearly defined standards and procedures to be met other than those established by DISC guidelines.

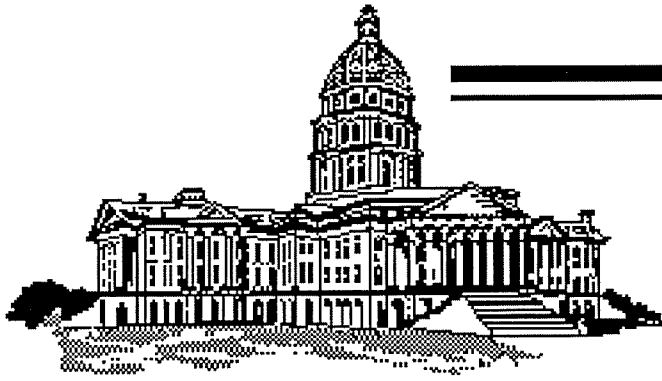
Sincerely,



Ralph W. E. Decker
Executive Director

JNR:dg

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PERFORMANCE AUDIT REPORT

Reviewing the Capacity and Use of the
State's Mainframe Computers

A Report to the Legislative Post Audit Committee
By the Legislative Division of Post Audit
State of Kansas
April 1992

92-41

*ACT Committee
Attachment 3
4-8-92*

Legislative Post Audit Committee

Legislative Division of Post Audit

THE LEGISLATIVE POST Audit Committee and its audit agency, the Legislative Division of Post Audit, are the audit arm of Kansas government. The programs and activities of State government now cost about \$6 billion a year. As legislators and administrators try increasingly to allocate tax dollars effectively and make government work more efficiently, they need information to evaluate the work of governmental agencies. The audit work performed by Legislative Post Audit helps provide that information.

We conduct our audit work in accordance with applicable government auditing standards set forth by the U.S. General Accounting Office. These standards pertain to the auditor's professional qualifications, the quality of the audit work, and the characteristics of professional and meaningful reports. The standards also have been endorsed by the American Institute of Certified Public Accountants and adopted by the Legislative Post Audit Committee.

The Legislative Post Audit Committee is a bipartisan committee comprising five senators and five representatives. Of the Senate members, three are appointed by the President of the Senate and two are appointed by the Senate Minority Leader. Of the Representatives, three are appointed by the Speaker of the House and two are appointed by the Minority Leader.

Audits are performed at the direction of the Legislative Post Audit Committee. Legislators or

committees should make their requests for performance audits through the Chairman or any other member of the Committee. Copies of all completed performance audits are available from the Division's office.

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LEGISLATIVE DIVISION OF POST AUDIT

1200 Merchants Bank Tower
8th & Jackson
Topeka, Kansas 66612-2212
Telephone (913) 296-3792
FAX (913) 296-4482

PERFORMANCE AUDIT REPORT

REVIEWING THE CAPACITY AND USE OF THE STATE'S MAINFRAME COMPUTERS

OBTAINING AUDIT INFORMATION

This audit was conducted by Mary Beth Green, Senior Auditor, and Murlene Priest and Rick Riggs, Auditors, of the Division's staff. If you need any additional information about the audit's findings, please contact Ms. Green at the Division's office.

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REVIEWING THE CAPACITY AND USE OF THE STATE'S MAINFRAME COMPUTERS

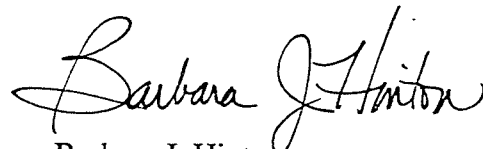
Summary of Legislative Post Audit's Findings

The Department of Administration operates two computer centers for the State, one using Unisys equipment and the other using IBM and IBM-compatible equipment. The Department of Human Resources, the Department of Social and Rehabilitation Services, and the six State universities also operate mainframe computers. To help address legislative concerns about these computers, this audit examined the use of nine of the 16 mainframes operated by State agencies as of January 1992.

To what extent are the State's mainframe computers currently underused or overused? Four of the nine mainframes reviewed were operating at or near capacity. In two of these four mainframes, the central processors appeared to be operating near capacity. The other two computers did not have enough main memory available for current uses. Three of the four machines operating near capacity also appeared to be nearing the end of their expected life.

The five remaining computers, which generally were in the early to middle years of their life expectancy, appeared underused at this time. In those cases, agency officials generally indicated that they had new applications planned that would significantly increase their mainframe computer use in the future. In addition, the federal funding used to acquire and operate two of these machines either limited the computer's uses or the agency's flexibility in obtaining new computer equipment. Finally, available data storage for several mainframes was full or nearly full, and the affected agencies soon may need to take some action to acquire more storage capacity.

The audit shows that, because of changing workloads, a mainframe computer is likely to be underused or overused at any particular point in its life cycle. As long as State agencies buy mainframe computers solely to meet the needs of their users, some mainframe overuse or underuse will likely remain a fact of life for the State. We would be happy to discuss the findings presented in this report with any legislative committees, individual legislators, or other State officials.



Barbara J. Hinton
Legislative Post Auditor

REVIEWING THE CAPACITY AND USE OF THE STATE'S MAINFRAME COMPUTERS

The Department of Administration operates two computer centers for the State, one using Unisys equipment and the other using IBM and IBM-compatible equipment. Audit work this office completed in March 1989 showed that the Unisys computer—which was processing the State's personnel, payroll, and accounting systems at that time—was operating close to capacity. Since then, the accounting functions have been transferred to an IBM-compatible computer. As reported in our January 1992 audit, Examining Problems Implementing the Kansas Financial Information Systems (KFIS), the Department had planned to move the personnel and payroll functions to IBM-compatible equipment as well. That project, however, ran far behind schedule and over budget. In late 1991, Department officials purchased a new Unisys mainframe computer that officials said would be better able to continue handling the personnel and payroll systems.

A number of other State agencies also have mainframe computers. Those agencies include the Department of Human Resources, the Department of Social and Rehabilitation Services, and several State universities. Legislative concerns have been raised about the use of these mainframe computers. To help address those concerns, the Legislative Post Audit Committee authorized this audit, which addressed the following question:

To what extent are the State's mainframe computers currently underused or overused?

To answer this question, we reviewed and analyzed information regarding computer use for a sample of the State's mainframe computers. To the extent possible, we analyzed four measures of performance for the mainframes—central processing unit use, internal computer response times and rates, paging rates, and the amount of disk storage space available on the computer. These measures are defined on page seven of the report. We interviewed State officials to determine how they used their computers and why the mainframes may be underused or overused. For the Department of Administration's mainframes, we also examined Department billing records to determine specifically how those computers were being used, and by which agencies.

In conducting this audit, we followed the applicable government auditing standards set forth by the U.S. General Accounting Office, except we did not verify the accuracy of the computer use and capacity data provided by the various State agencies. The data analyzed were contained in detailed reports generated by the computers reviewed. In general, those reports were produced using standard, industry software programs rather than programs designed by the individual agencies.

Overall, we found that four of the nine mainframe computers reviewed during the audit were operating at or near capacity. In two of these four mainframes, the central processors appeared to be operating near capacity. The other two computers did not have enough main memory available for current uses. The five remaining computers in our sample appeared to be underused at this time. These mainframes generally were in the early to middle years of their life expectancy, and agency officials had new applications planned that would significantly increase future use. In addition, the federal funding used to acquire and operate two of these machines either limited the mainframes' uses or the agency's flexibility in obtaining new computer equipment. Finally, the available data storage for several mainframes was full or nearly full, and the affected agencies may need to purchase additional storage space soon.

To What Extent Are the State's Mainframe Computers Currently Underused or Overused?

The workload of a mainframe computer generally increases over the course of its life cycle, and agency officials must anticipate that increase when buying a machine. As a result, a relatively new computer is likely to have significant unused capacity, and a mainframe nearing the end of its expected life is more likely to be operating near the limit of its capabilities.

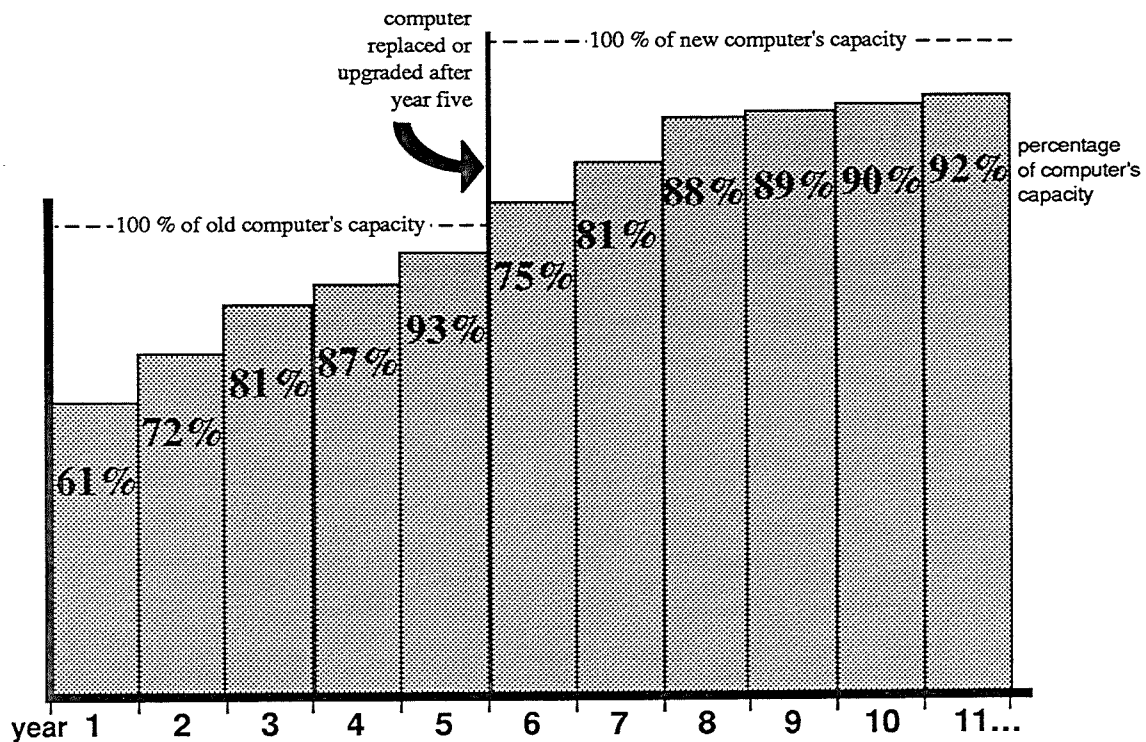
We found that four of the nine mainframe computers reviewed during this audit currently were operating at or near capacity. Most of these machines were nearing the end of their expected life. The five remaining computers, which generally were in the early to middle years of their life expectancy, appeared to be underused at this time. In those cases, agency officials generally indicated that they had new applications planned that would significantly increase their mainframe computer use in the future. In addition, the federal funding used to acquire and operate two of these machines either limited the computer's uses or the agency's flexibility in obtaining new computer equipment. Finally, available data storage for several mainframes was full or nearly full, and the affected agencies may need to purchase additional storage soon. These findings will be discussed in more detail after the following overview of mainframe computers.

Mainframe Computers Have a Limited Life Expectancy, and Their Workload Often Increases Over Time

For this audit, we defined a mainframe computer as a large computer which performed multiple tasks for multiple users, many of which work from remote locations. The machines generally also had external communication devices such as printers and terminals. These mainframe elements are shown in the illustration on page eight.

Many mainframe computers appear to have a life expectancy of about five years (beyond that time, the computers' technology often becomes outdated). Good planning requires that an agency buying a mainframe computer take into account probable increases in workload caused by new applications, new users, and the like. The graphic at the top of the following page illustrates how, as a machine nears its capacity, agency officials must decide whether to limit increases in workload or to expand that capacity. Generally, this decision should occur by the time average computer use reaches 80 to 90 percent of capacity, for two reasons. First, planning for and acquiring a new mainframe may require considerable lead time. Second, peak use will exceed average use, sometimes by a considerable amount. If peak use nears 100 percent too often, a number of problems may occur. For example, users may experience slower response time and have difficulty completing their work.

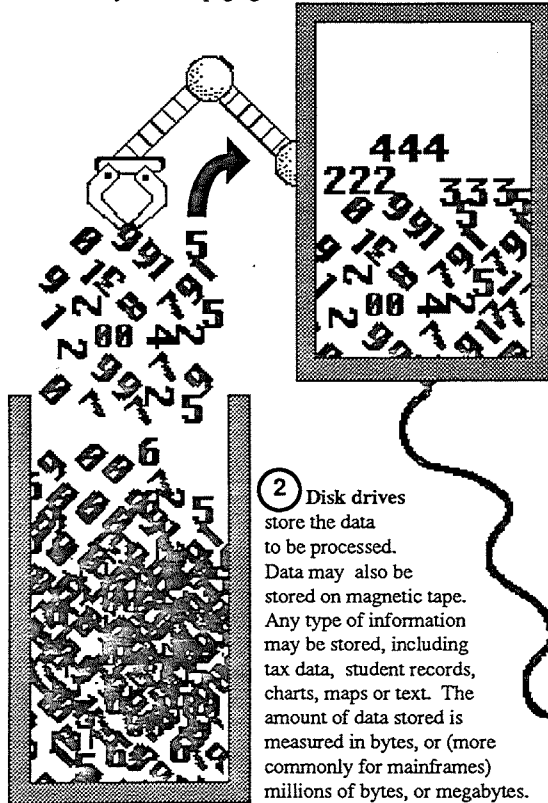
Increases in Computers' Workloads Often Require More and More of Their Capacity



In the agencies we reviewed, mainframe computers often appeared to be underused, but agency officials said they historically have experienced workload growth each year, or planned to add particular applications that would use more of their machines' capacity. In this hypothetical example, the old computer's workload grew each year until, after five years, the combined demand required more than 90 percent of the machine's capacity. The computer was replaced, and although the volume of work continued to grow, it consumed a smaller percentage of the new and larger machine's capacity. In practice, computer technical staff would begin planning to reduce the workload, or expand the machine's capacity through upgrade or replacement, when the average capacity used exceeded 80 to 90 percent.

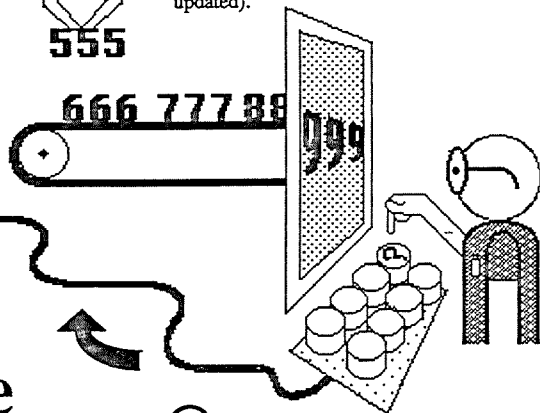
During this audit, we identified a total of 16 mainframe computers operated by State agencies and institutions. In general, mainframes were operated by the Departments of Administration, Human Resources, and Social and Rehabilitation Services, as well as the six State universities. A complete list of the 16 mainframes we identified is included in Appendix A. During the audit, we reviewed the capacity and use of a sample of nine of these mainframes in detail. Those nine computers are described in the table on page six.

③ The central processing unit takes stored information from the disk drives and moves it to main memory for processing. The amount of the processor's activity is measured by how much of the time it is in use. The act of moving blocks of data into and out of main memory is called paging.



④ Computer main memory is where the central processing unit actually performs its work, in this case sorting data. The amount of main memory determines how much data the computer can process at one time. Main memory size is also measured in megabytes.

⑤ After processing, the data might be displayed on a screen at a remote terminal, printed, or moved back into storage (for example, when records are updated).



① When the computer user makes a request of the computer, for example to sort a set of data, the request is made from a terminal, often in a remote location.

How a Mainframe Computer Processes Information

Characteristics and Uses of Mainframe Computers Reviewed During this Audit

Agency and Computer	Memory [in megabytes] and Power [in millions of instructions per second] (a)	Year Purchased	Major Uses
Department of Administration			
Unisys 1100-74	16 Mb 4.8 MIPS	1980- 1989 (b)	Statewide personnel and payroll system, debt set-off program
Amdahl 5890-600E	256 Mb 74 MIPS	1990	Department of Revenue motor vehicle and tax applications; Department of Administration's Statewide accounting system, and various programs for the Department of Transportation and the Department of Social and Rehabilitation Services
IBM 3084-Q	64 Mb 26MIPS	1986	State office automation programs, such as electronic mail
Department of Human Resources			
IBM 4381-T92	64 Mb 7.8 MIPS	1991	Unemployment insurance payments, employer contributions, job service programs, and various other support programs
Department of Social and Rehabilitation Services			
IBM 3090-400E	256 Mb 57 MIPS	1988	Client eligibility records, and various program records for child support enforcement, general assistance, vendor payments, food stamps, and Aid to Families with Dependent Children
Kansas State University			
IBM 3084-Q96	96 Mb 28 MIPS	1989	Administrative programs such as student records and financial aid, academic research, and library programs
University of Kansas			
Amdahl 5890-300E	128 Mb 42.5 MIPS	1990	Administrative programs for both the Lawrence and Medical Center campuses such as payroll, personnel, and student records, as well as library programs
IBM 3081 KX-3	32 Mb 15.5 MIPS	1988	Various statistical programs and office automation applications
DEC 9000-210	256 Mb 42 MIPS	1990	Academic research, instruction and electronic mail system

(a) The **memory size** of a computer is determined by the amount of information it can hold in the central processor's main memory at one time (only data currently stored in that memory location can be processed). This capacity is listed in millions of bytes, or megabytes (Mb). A computer's **processing power** can be measured by the number of instructions it can carry out in a given time. Processing power is most commonly measured in millions of instructions per second (MIPS).

(b) This computer originally was purchased in 1980; the last upgrade was made in 1989. In 1992, this mainframe was replaced with a Unisys 2200-423.

As the table shows, we reviewed all the mainframes operated by the Departments of Administration, Human Resources, and Social and Rehabilitation Services. We also examined the performance of Kansas State University's single mainframe, and of three mainframes operated by the University of Kansas. The only University of Kansas mainframe we did not review was a computer used exclusively by the Medical Center for hospital information and billing. In addition, we did not review the Department of Administration's new Unisys 2200-423 mainframe because it was not used to process the Statewide, monthly payroll in time to be included in this audit.

To determine whether these nine mainframe computers were being underused or overused, we reviewed available data for four potential measures of computer use: central processing unit use, internal computer input/output response times and rates, paging rates, and disk storage space. These four performance measures are defined in the box at the bottom of the page.

In the remainder of the report, we generally will focus on the percent of central processing unit capacity that was being used by each machine. This is one of the most common measures of mainframe use and refers to the percent of time that a mainframe's

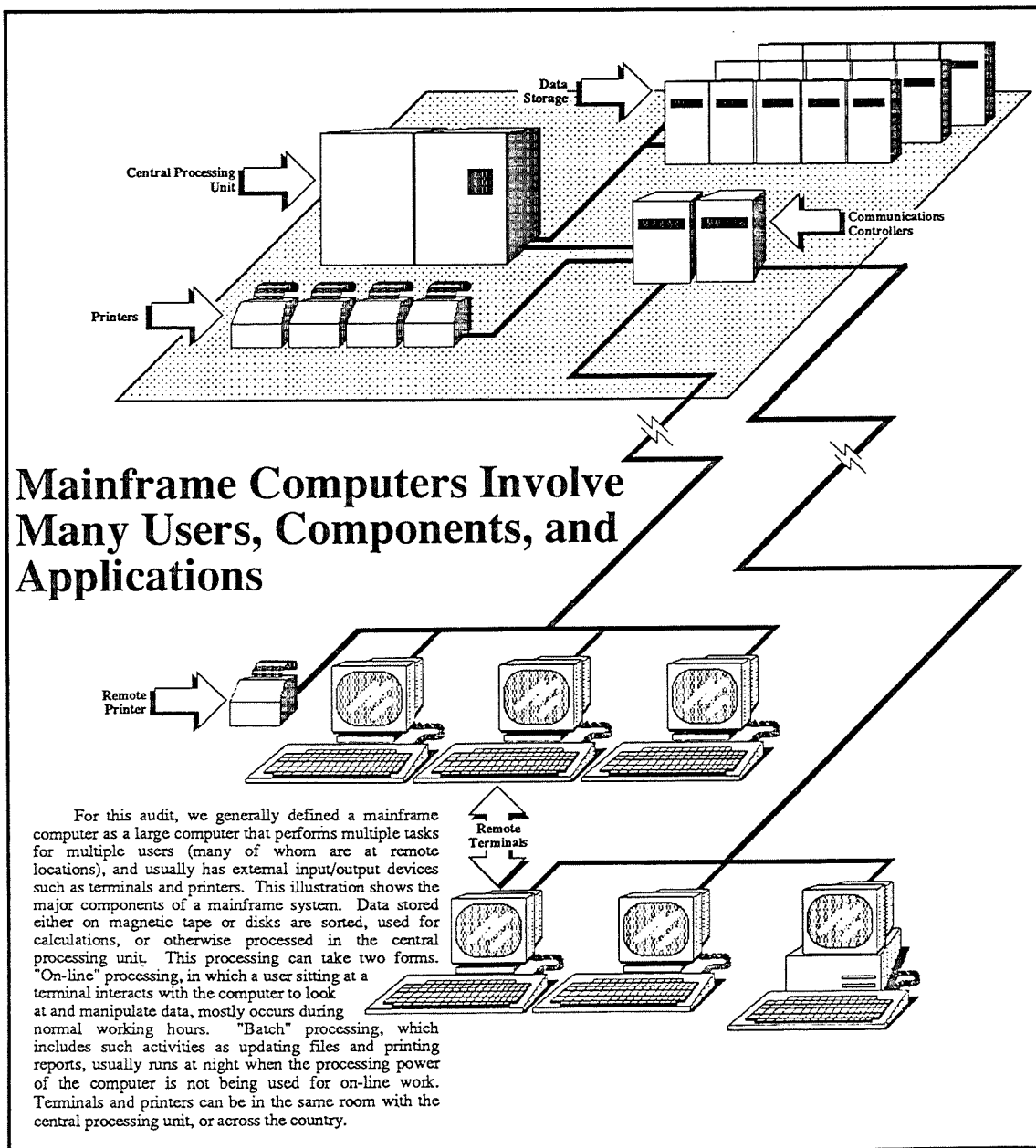
Measures of Computer Use Examined During this Audit

To determine whether the mainframes examined during this audit were being overused or underused, we examined four measures of computer use:

- **Central processing unit use**, or the percent of time that a mainframe's central processing units were actually being used. Central processing units perform the required manipulations of data to create the desired results. A machine with an average of 75 percent central processing unit use, for example, would be busy processing information three-fourths of the time. The higher this percentage, the closer to capacity a mainframe generally is operating.
- **Internal computer input/output response times and rates**, or the length and number of times that a mainframe's auxiliary storage devices (such as disk drives) respond to information requests from the central processing unit. High response times and rates may indicate that a mainframe is operating near capacity.
- **Paging rates**, or measures of how frequently a mainframe's central processing unit must trade some portion of data stored in its main memory for data stored in an auxiliary location such as a disk drive. Main memory is the computer's ability to store information for immediate use by the central processing unit, and paging is the ability of the system to move information in and out of main memory as needed by the central processing unit. Consistently high paging rates can mean that the computer's available main memory is too small.
- **Disk storage space**, or the amount of auxiliary data storage space available on the mainframe's disk drives. If a large percent of the disk storage space is occupied, some data may need to be removed from the computer's disk drives or an agency may need to purchase more disk storage.

central processing units were actually being used. Often, the data for the other measures merely supported our findings for central processing unit use. In the few cases when the other measures did not coincide with central processing use, the report also will discuss those findings. More detailed information about each mainframes usage during our sample period is included in Appendix B.

To determine how each mainframe was performing, we analyzed data for processing done during one week in January 1992. One exception to this was the Department of Administration's Unisys machine. For that mainframe we analyzed a two-week period during January to capture the machine's performance before and during monthly State payroll processing.



Four of the Nine Mainframes in Our Sample Appeared to Be Operating Near Capacity

Three of these four mainframes appeared to be nearing the end of their expected life cycle. In two cases—the University of Kansas' academic research mainframe and the Department of Administration's Unisys mainframe—it appeared that the central processor was operating at or near capacity. For two other mainframes it appeared that the available memory was too small even though the central processor was not being over-used.

The following table summarizes the amount of central processing unit capacity that was being used by each of these four mainframes during our sample period.

**Average and Peak Mainframe Capacity in Use
During January 1992**

<u>Agency and Computer</u>	<u>Percent of Central Processor Used During....</u>		
	<u>Entire Day (a)</u>	<u>Normal Work Hrs.(b)</u>	<u>Peak Reading(c)</u>
University of Kansas DEC 9000-210	95.8%	(d)	100.0%
Department of Administration Unisys 1100-74 (e)	57.4	75.4	98.1
University of Kansas IBM 3081 KX-3	25.6	35.7	97.0
Department of Administration IBM 3084-Q	(d)	40.1	85.2

- (a) These figures represent the average percent of time the mainframes' central processing units were busy based on a 24-hour day.
- (b) These figures represent the average percent of time the mainframes' central processing units were busy during normal work hours, approximately 8:00 a.m. to 5:00 p.m.
- (c) These figures represent the highest central processor reading during our sample period.
- (d) These figures were not available for this mainframe.
- (e) These figures represent the average percent of time the mainframe's central processing units were busy during the week when the Statewide, monthly payroll was being processed.

As the table shows, during normal work hours the University of Kansas' DEC 9000 and the Department of Administration's 1100-74 were running near capacity during our sample period. On average, the table shows that the Department of Administration's IBM 3084 and the University of Kansas 3081 were being used less than half the time during our sample period. Our analysis, however, indicated that despite the relatively low central processor use, those machines were using an undesirably high percent of their main memory.

Definitions of Terms Used in this Report

Main Memory: This is the computer's working storage that is made up of a collection of computer chips. The size of the main memory determines the number and size of computer applications that can be used at the same time as well as the amount of data that can be processed. All program execution and data processing takes place in this memory.

Byte: The common unit of computer storage used in all types of computers. A byte holds the equivalent of a single character, such as a letter "A", a dollar sign, or a decimal point.

Megabyte: One million characters or bytes. The main memory of a computer or the amount of storage space available on a computer disk drive is often measured in megabytes.

MIPS: One Million Instructions Per Second. This is the instruction execution speed of a computer. For example, 0.5 MIPS is 500,000 instructions per second. MIPS rates are not uniform across all types of computers and some MIPS rates are averages or best case scenarios developed by the computer manufacturer.

On-Line Processing: A user sitting at a computer terminal is able to look up, manipulate, and up-date data files. All of these transactions immediately affect the data files.

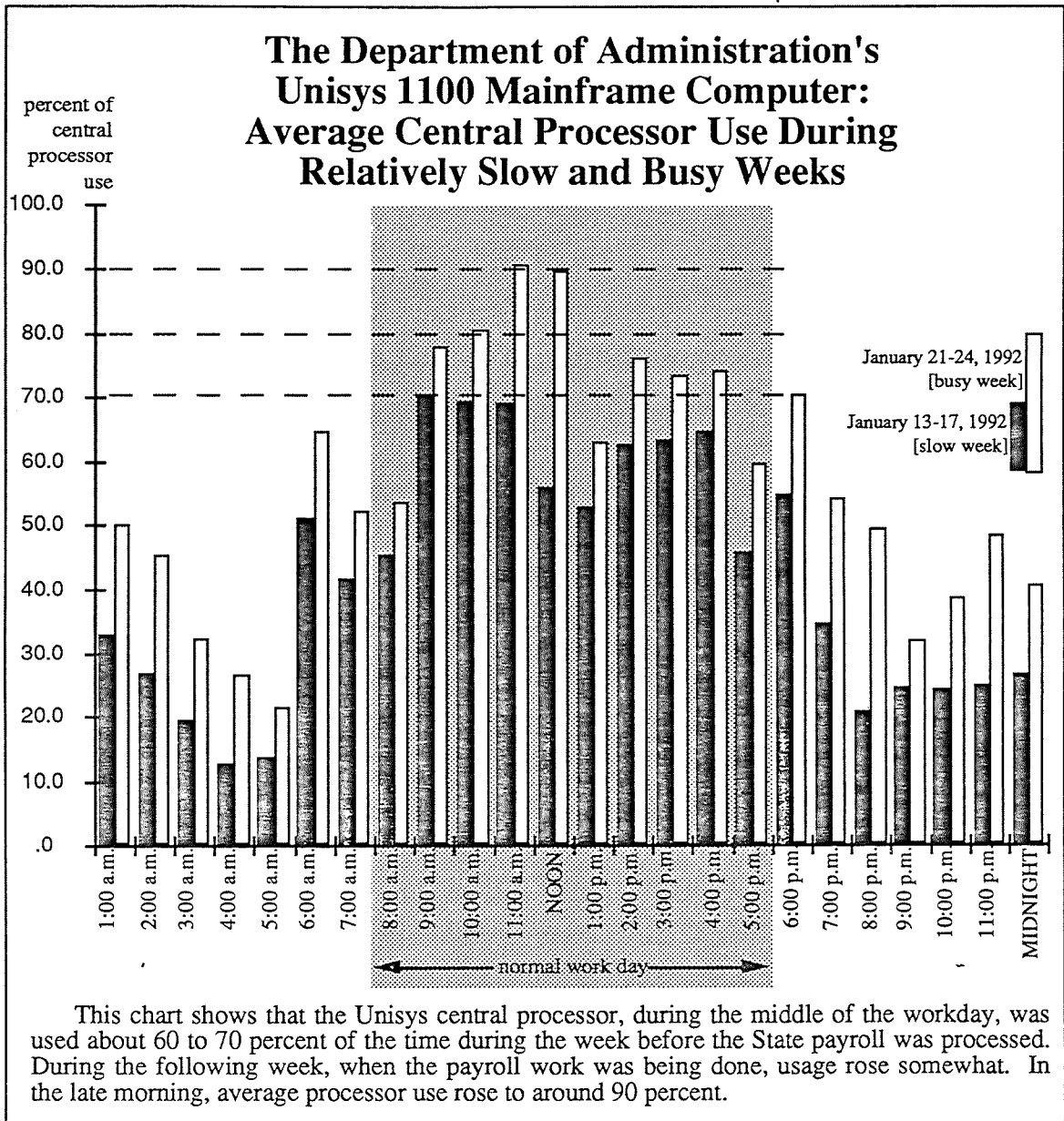
Batch Processing: Transactions are collected throughout a day and processed at night. Batch processing generally includes such activities as updating files and printing reports.

The University of Kansas' DEC 9000 was running near full capacity, primarily because of the type of work performed on the computer. For the week of January 13-17, 1992, we found that the DEC 9000's central processing unit was running almost 96 percent of the time, 24 hours per day. This mainframe is used primarily for academic research and instructional purposes.

University officials generally indicated that, because of the nature of the processing done on the DEC 9000, they are not overly concerned about the high usage of the machine. According to University staff, the mainframe operates at maximum capacity most of the time for three reasons. First of all, it does not experience significant "slow" periods because it is used for on-line processing at all hours of the day and evening. Secondly, its users often run complex statistical software that uses a lot of central processing time and power. Finally, some of the mainframe's users have research projects that are designed to run automatically whenever the computer has any unused capacity.

The Department of Administration's Unisys 1100 mainframe was operating near capacity, particularly during the week when the State payroll was being processed. The Unisys mainframe is used primarily to process the State's payroll and personnel records. We examined computer records for two periods in January 1992. The week before the February State payroll was processed, January 13-17, was characterized by Department officials as the part of the month when processing on the Unisys was at a minimum. In contrast, they indicated that January 21-24, during the week when the payroll processing took place, was the busiest part of the month. The chart on the facing page shows what we found when we compared the two periods.

As the chart shows, the Unisys machine's use was significantly higher during the second week reviewed. Our review showed that average use during the 8:00 a.m. to 5:00 p.m. workday was 62.0 percent during the "slow" week. The comparable average during the busier second week was 75.4 percent. The Unisys computer was also busy an average of about 70.2 percent of the time during peak use in the relatively slow week.



During the subsequent week, when the monthly State payroll was being processed, average peak use jumped to more than 90 percent. Department officials indicated that the Unisys 1100 mainframe should not, as a rule, be busy more than 85 to 90 percent of the time, to allow for expected peaks in usage during the day.

In late 1991, the Department purchased a new Unisys mainframe for about \$3 million. The new computer, a Unisys 2200-423, was installed in February and March 1992. With 32 megabytes of main memory, the new Unisys mainframe is twice as large in that respect as the old machine. According to Department and Unisys officials, the new mainframe's operating system will also use more of the computer's main memory. The new Unisys also processes information quicker, processing 5.2 million in-

structions per second rather than the 4.8 million per second for the 1100-74. In terms of main memory, both the old and new Unisys mainframes are relatively small machines and are significantly smaller than the Department of Administration's Amdahl 5890.

According to Department officials, the new Unisys mainframe was necessary to prevent a failure in the Unisys system and the resulting disruption of the Statewide payroll process. Department staff indicated that the upgrade was made primarily to improve the Unisys' operating system, rather than specifically to increase capacity. The new machine's enhanced capacity and operating system may allow it process payroll and personnel transactions at a lower percent of total capacity.

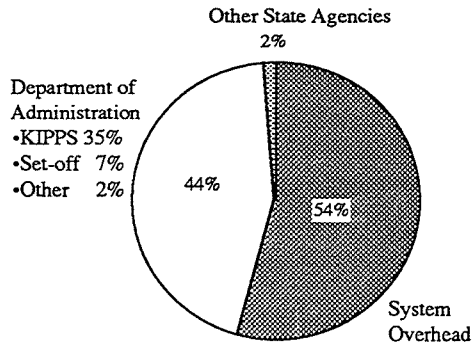
The Department of Administration's IBM 3084 and the University of Kansas' IBM 3081 appeared to have insufficient main memory even though their central processors were not overused. As shown in the table on page six, the Department of Administration's IBM 3084 has a main memory capacity of 64 megabytes. This made it one of the smaller of the nine machines we examined for this audit. Our review of performance data for this machine showed that its paging rate averaged 365 pages per second during the day, and ran as high as 623 pages per second. Although Department officials indicated that the maximum paging rate for this machine should be 400 pages per second, we found that the machine exceeded this rate nearly half the time during normal work hours. As indicated earlier in this report, relatively high paging rates can indicate that a mainframe does not have sufficient main memory for its current uses. Department technical staff confirmed that the high paging rates could start to increase user response times.

The table on page six shows that the University of Kansas' IBM 3081 is also one of the smaller machines we reviewed in terms of main memory capacity (32 megabytes), and it also showed a relatively high paging rate. University technical staff said that a paging rate consistently in excess of 100 pages per second would indicate that available main memory for this machine was overtaxed. We analyzed data generated by the computer over a four-day period showing that the 3081's average paging rate ran as high as 121 pages per second during the day. Peak paging rates averaged about 356 pages per second.

University officials agreed that the 3081 is overloaded. Officials said that the only way to remedy the problem is with an expensive upgrade they are reluctant to perform because the 3081 has become outdated. Therefore, officials said that the 3081 will be turned off in June 1992, and its functions will be divided among two or more other computers. Statistical programs currently run on the 3081, which process large amounts of data and make heavy demands on the computer's memory, will be transferred to a smaller, more specialized computer. University officials plan to move the 3081's remaining functions to their Amdahl 5890 mainframe.

The Primary Uses of the Department of Administration's Mainframe Computers

The Department of Administration's Division of Information Systems and Communication operates three mainframe computers for Statewide use. As described below, we reviewed the Division's recent billing records to identify the primary uses of those three computers. According to Department officials, these billing records may not completely reflect computer use for a number of reasons. (For example, some computer usage is not captured by the billing systems.) The primary users of each mainframe are described in more detail in Appendix C.

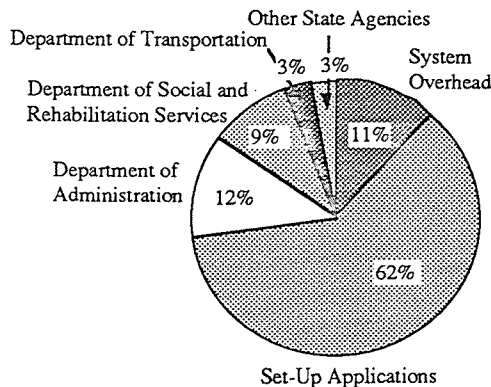
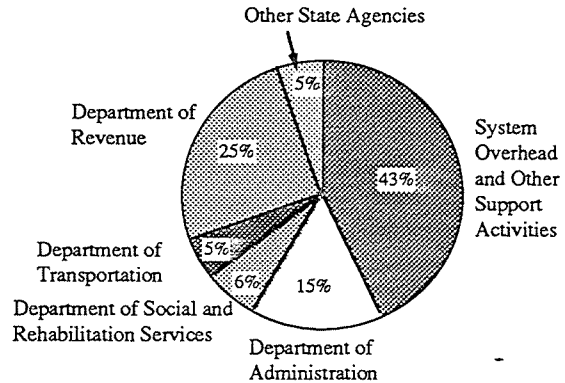


Unisys 1100-74

In calendar year 1991, slightly more than half (54 percent) of the Unisys 1100-74's processing time was used for system overhead, such as the mainframe's operating system and data file maintenance. Other than overhead, the computer was used primarily by the Department of Administration for the State's integrated personnel and payroll system (KIPPS) and the debt set-off program. In February and March 1992, the Department replaced this computer with a Unisys 2200-423 mainframe computer.

Amdahl 5890

The Amdahl 5890 is the largest IBM-compatible mainframe computer operated by the Department of Administration. Between February 1991 and January 1992, it was used primarily by four State agencies: the Departments of Revenue, Administration, Social and Rehabilitation Services, and Transportation. The Department of Revenue was the largest user of the 5890, using the mainframe for motor vehicle registration and licensure, all types of taxes, and other administrative functions. The Department of Administration was the second largest user, using the mainframe for the Statewide accounting system and some payroll and personnel functions. In addition, about 43 percent of computer use was system overhead (such as file maintenance, back-up and the operating system) and other system support activities (such as on-line system monitors, databases, and computer center administration).



IBM 3084

Between August 1991 and February 1992, the IBM 3084 mainframe computer was used primarily by three State agencies. The Department of Administration used the computer for electronic mail and some duties related to the Statewide accounting system. The Department of Social and Rehabilitation Services used the computer for electronic mail and word processing. The Department of Transportation used the computer for its executive information system and electronic mail. The majority of computer use (62 percent) was dedicated to setting up user accounts so that computer users from various State agencies can access the IBM 3084.

**The Five Remaining Mainframes Appeared to be Underused
At this Time, But Agency Officials Said They
Planned to Add New Applications in the Near Future**

For the five remaining machines reviewed during this audit, we found that they appeared to be underused during the January 1992 time period we examined. These mainframes generally were in the first or second years of their four- to five-year life expectancy, and the agencies had new applications planned that they said would use up most of that excess capacity over the expected life of the machine. In addition, some agencies indicated they experience seasonal fluctuations in mainframe use that was not reflected during our sample period. Finally, agency officials told us that the federal funding used to acquire and operate two of these machines either limited the uses of those machines or affected the length of time they needed to acquire additional computer equipment.

These five mainframes, and the average capacity in use during our sample period, are summarized below.

**Average and Peak Mainframe Capacity in Use
During January 1992**

<u>Agency and Computer</u>	<u>Percent of Central Processor Used During....</u>		
	<u>Entire Day (a)</u>	<u>Normal Work Hrs.(b)</u>	<u>Peak Reading(c)</u>
Kansas State University IBM 3084	48.6% (d)	54.2%	91.2%
Department of Administration Amdahl 5890	37.0	55.1	84.6
Department of Human Resources IBM 4381	32.2	45.3	85.5
University of Kansas Amdahl 5890	27.9	41.5	92.5
Social and Rehabilitation Services IBM 3090	17.8	37.3	57.6

- (a) Except as noted in (d), these figures represent the average percent of time the mainframes' central processing units were busy based on a 24-hour day.
- (b) These figures represent the average percent of time the mainframes' central processing units were busy during normal work hours, approximately 8:00 a.m. to 5:00 p.m.
- (c) These figures represent the highest central processor reading during our sample period.
- (d) These figures represent the average percent of time the mainframe's central processing units were busy between 8:00 a.m. and midnight. The computer did not produce figures for an entire 24-hour period.

As the table shows, central processor use during normal work hours (approximately 8:00 a.m. to 5:00 p.m.) ranged from 37.3 percent for the Social and Rehabilitation Services IBM machine to 55.1 percent for the Department of Administration's Amdahl machine. During normal work hours, all five computers operated, on average, at about half capacity or less. Average computer use during entire 24-hour days was even lower.

Peak usage was considerably higher than the averages. For example, high usage for the University of Kansas' Amdahl 5890 was 92.5 percent, more than twice as high as its average use during normal work hours. The lowest peak use for our sample occurred on the Department of Social and Rehabilitation Services' IBM 3090, which peaked at less than 60 percent.

Agency officials generally indicated that they must provide sufficient computer capacity to accommodate peak workloads during normal hours. During those times, the machines were generally used for on-line, rather than batch, processing. As the use graph for the Department of Administration's Unisys computer on page 11 illustrates, computer use generally peaks in the middle of the day, tapering off in early morning and late afternoon.

Most agency officials told us that although their machines were not fully used right now, future use is likely to be heavier. All five of the machines that appeared to be underused have been purchased since 1988, with a life expectancy of about five years. Three of the machines were one or two years old. The University of Kansas' Amdahl 5890, for example, was purchased in 1990 and University staff expect it to have a four- to five-year life. University officials said they historically have experienced about a 25 percent growth in workload each year. Additionally, they said that they plan for growth because they are paying for the computer over several years and would not want to outgrow the machine before it is fully paid for.

For all five of the mainframes that appeared to be underused at this time, agency officials indicated they planned to increase mainframe use by adding computer applications in the future. Some of the major applications planned for 1992 included:

- The Department of Social and Rehabilitation Services' IBM 3090 was operating at less than 40 percent of central processor capacity during normal work hours for our sample week. Later in 1992, the Department plans to add a new application related to client employment and child care records. Department staff estimate this application could boost average central processor use to about 70 percent.
- The Department of Transportation will be adding two new applications for project construction and management to the Department of Administration's

Amdahl 5890 later this year. The Department of Administration's preliminary estimates indicated that these projects could increase use of that mainframe by 14 to 25 percent.

- The University of Kansas plans to begin using a library system that will allow searches of large, bibliographic databases, allowing users to access bibliographic information contained in several databases on campus and at other universities across the country. University officials anticipate heavy use of this new software, which would significantly increase the use of the Amdahl 5890 mainframe. Also, as noted earlier, the University's IBM 3081 will be taken out of service in June 1992 and many of its functions will be transferred to the Amdahl 5890.

In some cases, agency computer use may be heavier at certain times of the year. Universities in particular may experience seasonal periods of more intensive computer use. For example, Kansas State University supplied data for a week in November 1991 that showed an average daytime usage of about 64 percent, or 18 percent higher than the average use during our sample week in January 1992. According to University officials, the higher usage rate occurred because pre-registration for the Spring semester was held in November. Officials at the University of Kansas indicated they had experienced some similar increases, but did not provide data to show how much.

Federal funding restrictions can limit State agencies' flexibility. Social and Rehabilitation Services' officials told us that the federal government closely monitors what programs are placed on the IBM 3090 and how much processing time each program uses because federal funding is paying for some of the computer equipment, maintenance, and operating costs. For example, federal food stamp program funds contributed to the computer's purchase, and those funds continue to pay a portion of its operation costs. To continue to receive food stamp funding, State officials must furnish usage data showing that the food stamp program comprised at least 30 percent of actual computer usage. If usage drops below 30 percent, the Department would be required to reimburse the federal government a portion of funds already received.

Similarly, the Department of Human Resources' IBM 4381 was purchased with U.S. Department of Labor grant funds. Department officials said federal regulations prohibit them from using their computer for work not related to unemployment compensation or other labor-related purposes. Officials said that regular Department of Labor audits look at what the mainframe is being used for. In addition, because it can take two to three years to complete the grant application process and acquire a new mainframe, Human Resources' staff indicated they must practice long-range planning to ensure that they have adequate mainframe capacity to meet changes in workload and use.

In Some Cases, Agencies' Data Storage Needs May Exceed Their Capacity

Mainframe computers store data on magnetic disks that can provide data directly to the central processing unit. (Computer records can also be stored on magnetic tape, but generally must be loaded onto a disk before they can be used by the computer.) For the mainframe computer installations we reviewed, some agency officials indicated that their computer's disk storage capacity was full or nearly so. In other cases, officials said their data storage was expected to be taken up by planned new projects within the next year or two. For example:

- The Department of Administration's old Unisys computer disk storage space was almost 90 percent full. In addition, about nine times more data were stored on tape than on the available disk space. (According to Department officials, the Unisys disk drives were replaced when the Department acquired the 2200-423, but the amount of storage is about the same.)
- The Department of Administration's Amdahl 5890's disk storage has only about 10 percent of its total space available to handle new growth.
- The University of Kansas' Amdahl 5890's disk space is expected to be filled up with the acquisition of new databases next year.

In many cases, these problems can be remedied by buying more or bigger disk drives. Acquiring more disk storage does not mean that the computer itself must be replaced or upgraded.

Conclusion

Many mainframe computers, because of workload growth, improvements in technology, and other reasons, generally seem to have a life expectancy of about five years before agencies replace them. Because the amount of work handled by computers generally grows year by year, agencies must buy machines big enough to meet users' needs not just now, but five or more years from now.

As shown in this audit, at any point in its life cycle a computer is likely to be underused or overused, too big or too small. For only a relatively short part of its expected life is it likely to be just what the agency needs. As long as each agency buys machines solely to meet its own needs, some mainframe overuse and underuse will likely remain a fact of life for the State.

If the Legislature wishes to explore ways to change the current situation, some policy options may exist. One of those could be a State policy that en-

courages consolidation of some mainframe functions. However, any attempt to affect how agencies buy and use mainframe computers would have to take into account a wide variety of technical considerations, as well as logistical and political obstacles. Any such effort would undoubtedly involve a carefully formulated plan carried out over several years.

Appendix A

Mainframe Computers Currently Operated by State Agencies and Institutions

For this audit, we defined a mainframe computer as a large computer which performs multiple tasks for multiple users (many of which are at remote locations) and usually has external input-output communications devices. Using that definition, we identified a total of sixteen mainframe computers currently operating in State government agencies and institutions:

<u>Agency/Institution</u>	<u>Computer(s)</u>
Department of Administration	Unisys 1100-74 (a) Amdahl 5890-600E (a) IBM 3084Q (a)
Department of Social and Rehabilitation Services	IBM 3090-400E (a)
Department of Human Resources	IBM 4381 (a)
Emporia State University	IBM 4381 P13 IBM 9370-20
Fort Hays State University	IBM ES 9000-260
Kansas State University	IBM 3084 Q96 (a)
Pittsburg State University	PRIME 6350 PRIME 5340
University of Kansas	Amdahl 5890-300E (a) IBM 3081 KX3 (a) DEC 9000-210 (a)
University of Kansas Medical Center	IBM 3081K
Wichita State University	IBM ES 9000-440

(a) The performance of this computer was reviewed in detail in this audit report.

Appendix B

Characteristics and Uses of Mainframe Computers Reviewed During This Audit

This Appendix describes each of the mainframe computers reviewed during the audit. In addition, for each mainframe it shows three of the performance measures reviewed: central processing unit use, paging rates, and disk storage space. These terms are defined in the table on pages 22 and 23.

Characteristics and Use of Mainframe Computers Reviewed During This Audit

<u>Agency and Computer</u>	<u>Memory/ Capacity(a)</u>	<u>Year Purchased</u>	<u>Cost</u>	<u>Expected Life at Purchase</u>	<u>Major Uses</u>
Dept. of Administration					
Unisys 1100-74	16 Mb 4.8 MIPS	1980- 1989 (e)	(f)	5 yrs.	Statewide personnel and payroll system, debt set-off program.
Amdahl 5890-600E	256 Mb 74 MIPS	1990	\$2,446,000	5 yrs.	Dept. of Revenue motor vehicle and tax applications; Dept. of Administration's Statewide accounting system and various programs for the Dept. of Transportation and Social and Rehabilitation Services.
IBM 3084-Q	64 Mb 26 MIPS	1986	\$1,818,618	5 yrs.	State office automation programs such as electronic mail
Dept. of Human Resources					
IBM 4381-T92	64 Mb 7.8 MIPS	1991	\$325,000	4-5 yrs.	Unemployment insurance payments, employer contributions, job service programs, and various other support systems.
Dept. of Social and Rehabilitation Services					
IBM 3090-400E	256 Mb 57 MIPS	1988	\$6,512,094	5 yrs.	Client eligibility records, child support enforcement program, general assistance programs, vendor payment records, food stamp program, and Aid to Families with Dependent Children program.
Kansas State University					
IBM 3084-Q96	96 Mb 28 MIPS	1989	\$550,000	5 yrs.	Administrative programs such as student and financial aid records; academic research, and library programs
University of Kansas					
Amdahl 5890-300E	128 Mb 42.5 MIPS	1990	\$1,800,000	4-5 yrs.	Administrative programs for both the Lawrence and Medical Center campuses such as payroll and personnel records, student records, and library programs.
IBM 3081KX-3	32 Mb 15.5 MIPS	1988	\$410,000	3 yrs.	Various statistical programs and office automation applications
DEC 9000-210	256 Mb 42 MIPS	1990	\$878,400	5 yrs.	Academic research, instruction and an electronic mail system.

- (a) The memory size of a computer is determined by the amount of information it can hold in the central processor's main memory at one time (only data currently stored in that memory location can be processed). This capacity is listed in millions of bytes, or megabytes (Mb). A computer's processing power can be measured by the number of instructions it can carry out in a given time. Processing power is most commonly measured in millions of instructions per second (MIPS).
- (b) The average percent of central processor used refers to the percent of time the mainframe's central processing units were actually being used during our sample period. Whenever available, figures are presented based on 24-hour days, as well as normal work hours (generally 8:00 a.m. to 5:00 p.m.).
- (c) Paging refers to how frequently a mainframe's central processing unit must trade some portion of data stored in its main memory for data stored in an auxiliary location such as a disk drive. Paging is measured in number of pages per second. Consistently high paging rates can mean that the computer's available main memory is too small.

Summary of Use During Our Sample Period

Major Planned Applications	Ave. Percent of Central Processor Used (b)	Paging Rate (c)	Percent of Disk Space Used (d)
None. In March 1992, the 1100-74 was replaced with a Unisys 2200-423 and there are no new projects planned for the 2200.	57.4 % (24-hr.) 75.4 % (work hrs.)	(g)	87.3%
Dept. of Transportation's two applications for project construction and management; a revision of the Dept. of Revenue's tax programs.	37.0% (24-hr.) 55.1% (work hrs.)	4.5 pages/sec (24-hr.) 8.9 pages/sec (work hrs.)	80.0%
None.	40.1% (work hrs.)	365 pages/sec (work hrs.)	64.0%
An extended benefits program, conversion of all employment records to database, and image processing for claims data which will require new storage devices and image scanners.	32.2% (24-hr.) 45.3% (work hrs.)	.2 pages/sec (24-hr.) .5 pages/sec (work hrs.)	100.0%
Expanded applications for client employment and child care records; enhancements to the child support enforcement programs.	17.8% (24-hr.) 37.3% (work hrs.)	.1 pages/sec (24-hr.) .2 pages/sec (work hrs.)	68.0%
A new financial aid management program (added in Feb. 1992); personnel program, and expanded library applications.	48.6% (h) 54.2% (work hrs.)	15 pages/sec (h) 21 pages/sec (work hrs.)	84.0%
Expanded library databases, distributed on-line enrollment system, and transfer of programs from the IBM 3081KX-3.	27.9% (24 hr.) 41.5% (work hrs.)	(i) .8 pages/sec (24-hr.) 1.9 pages/sec (work hrs.) 4.0 pages/sec (24-hr.) 10.2 pages/sec (work hr.)	93.1%
None. This computer will be shut down in June 1992.	25.6% (24-hr.) 35.7% (work hrs.)	51.7 pages/sec (24-hr.) 120.7 pages/sec (work hrs.)	85.7%
None.	95.8% (24-hr.)	1.8 pages/sec (24-hr)	60.0%

(d) The percent of disk storage space used represents the amount of disk space (auxiliary storage such as disk drives) that is occupied.

(e) This computer was originally purchased in 1980; the last upgrade was made in 1989. In 1992, this mainframe was replaced with a Unisys 2200-423.

(f) The Unisys computer has been upgraded four times since 1980. With each upgrade, the Department kept some equipment while acquiring additional components. The cumulative cost of the Unisys 1100-74 covers almost 12 years and totals about \$5.5 million. This amount does not include software, licenses, installation, hardware maintenance, or software maintenance.

(g) These figures were not available for this mainframe because the machine does not perform this function.

(h) These figures represent the average percent of the mainframe's central processing units that were busy between 8:00 a.m. and midnight. This computer did not produce figures for an entire 24-hour period.

(i) Because this mainframe produces separate figures for its two different operating systems, two sets of figures are presented here.

Appendix C

Primary Uses of the Department of Administration's Mainframe Computers

This Appendix presents a detailed look at the primary uses of the Department of Administration's mainframe computers and is intended to supplement the charts on page 13 of the report. The information included in this Appendix is based on various Department billing records for its three mainframe computers. Any differences in the percentages listed in this Appendix and the percentages on page 13 are due to rounding.

Primary Uses of the Department of Administration's Mainframe Computers

Use of the Unisys 1100-74 (Calendar Year 1991)	Percent of Use (a)	
System Overhead:		
Mapper - includes a portion of the operating system as well as the application for data retrieval and report formatting	40.8 %	System Overhead is a collection of computer programs which allow the computer to run. It includes operating systems, applications, and many other files.
Computer Automated Reporting System - tracks daily and monthly computer usage	5.3	
Operating System	0.5	
Other Overhead Files	7.7	
Subtotal, System Overhead:	54.3 %	
Department of Administration:		
Kansas Integrated Personnel and Payroll System	35.0 %	
Central Accounting including Set-off	7.4	
Division of Accounts and Reports	1.5	
Other Department of Administration Uses	0.4	
Subtotal, Department of Administration:	44.3 %	
Other State Agencies:		
Department of Health and Environment	1.0 %	
Kansas Corporation Commission	0.4	
Subtotal, Other State Agencies:	1.4	
Total of All Uses:	100.0 %	
Use of the IBM 3084 (August 1991 to February 1992)	Percent of Use (a)	
Operating System:	11.6 %	
Account Set-Up:		
Department of Administration (b)	56.7	Account Set-up is a part of the computer's operating system which allows users from various State agencies to access the IBM 3084.
Department of Social and Rehabilitation Services	2.8	
Department of Transportation	1.9	
Department of Human Resources	0.2	
Other Agencies	0.3	
Subtotal, Account Set-Up:	61.9 %	
Department of Administration:		
Profs - electronic mail system	4.5 %	
Focus - an application for data retrieval and management reporting	3.7	
Statewide Accounting and Reporting System (STARS)	3.4	
Other Small Applications Used by the Department	0.5	
Subtotal, Department of Administration:	12.1 %	
Department of Social and Rehabilitation Services:		
Profs - electronic mail system	8.2 %	
Word Perfect - a word processing application	0.7	
Other Small Applications Used by the Department	0.1	
Subtotal, Department of Social and Rehabilitation Services:	9.0 %	
Department of Transportation:		
Pilot - a management information and reporting system	1.8 %	
Profs - electronic mail system	1.0	
Other Small Applications Used by the Department	0.3	
Subtotal, Department of Transportation:	3.1 %	
Other State Agencies:		
Profs and Other Small Applications	2.3 %	
Total of All Uses:	100.0 %	

(a) Usage was determined by reviewing the Department of Administration billing records for the amount of central processing time used during the period indicated, and the percentage is based on the total billed computer usage during that time. According to Department officials, billing records may not completely reflect computer use for several reasons. For example, some usage may not be captured by the billing system.

(b) According to Department of Administration officials, this amount includes user access for the Department of Administration as well as some support activities, such as back-up procedures for the electronic mail system.

Use of the Amdahl 5890 (February 1991 to January 1992)

**Percent
of Use (c)**

System Overhead and Other Support Activities:	
Technical Support, Operating and Billing Systems	14.2 %
Customer Information Control System Regions and Network	13.7
Database Management and Production	8.7
DISC Administration and Systems Maintenance	2.4
Telecomm Billing	0.9
Data Storage Management	0.7
KANS-A-N Telephone Billing System	0.2
Other Subsystem and Database Uses	2.6
Subtotal, System Overhead and Other Support Activities:	43.4 %
Department of Administration:	
STARS Development, Testing, and Production	10.0 %
Payroll and Personnel Services	3.4
Central Accounting	0.4
Automated Human Resource System (KAHRS) Development and Testing	0.3
Division of Accounts and Reports	0.2
Other Department of Administration Uses	0.5
Subtotal, Department of Administration:	14.8 %
Department of Transportation:	
Fiscal Administration	1.3
Transportation Systems Planning	1.0
Construction and Maintenance	0.8
Computer Services Administration	0.7
Design for State Construction	0.3
Districts 1 to 6 Construction and Maintenance	0.3
Traffic Engineering and Safety	0.2
Other Department of Transportation Uses	0.4
Subtotal, Department of Transportation:	5.0 %
Department of Revenue:	
Motor Vehicle Registration, Licensure, and VIPS	13.3 %
Taxes - All Types	5.5
Operations and Technical Support	5.2
Account Maintenance, Reports, and Investigations	0.5
Property Valuation and Reappraisal	0.4
Other Department of Revenue Uses	0.4
Subtotal, Department of Revenue:	25.3 %
Department of Social and Rehabilitation Services:	
Customer Information Control System	2.6 %
Automated Eligibility and Child Support Enforcement System (KAECSES) Data Storage	1.4
Income Maintenance	0.6
Data Processing	0.3
Rehabilitation Programs and Mental Health	0.3
Area Office Administration	0.1
Aid to Families with Dependent Children	0.1
Other Department of Social and Rehabilitation Services Uses	1.0
Subtotal, Department of Social and Rehabilitation Services:	6.4 %
Other State Agencies:	
Kansas Public Employees Retirement System	1.4 %
Department of Health and Environment	0.7
Board of Education	0.5
Revisor's Office	0.4
Board of Agriculture	0.4
Kansas Corporation Commission	0.3
Kansas Wildlife and Parks Department	0.3
Capitol Area Security Patrol	0.3
Kansas Bureau of Investigation	0.3
Judicial Branch	0.2
Other Miscellaneous State Agencies	0.3
Subtotal, Other State Agencies:	5.1 %
Total of All Uses:	100.0 %

(c) Usage was determined by reviewing the Department of Administration's billing records for total dollar amounts charged to users during the time period indicated. These amounts include charges for computer use as well as peripheral charges such as data storage and printing. According to Department officials, billing records may not completely reflect computer use for several reasons. For example, some computer use may not be captured by the billing system.

Appendix D

Agency Responses

On March 30, 1992, copies of the draft audit report were sent to the Department of Administration, the Department of Human Resources, the Department of Social and Rehabilitation Services, Kansas State University, and the University of Kansas for review and comment. The written responses received from the Department of Administration, the Department of Human Resources, and the Department of Social and Rehabilitation Services are presented in this Appendix. Kansas State University and the University of Kansas indicated they did not have written responses to the audit.

In their response, Department of Administration officials indicated that they did not think the information presented in the audit concerning the primary users and uses of the Department's mainframe computers was entirely accurate. According to Department officials, the Department's billing records may not be highly reliable for determining actual computer use for various reasons. For example, the billing systems may not capture certain uses of the computer. In addition, the billing system does not always charge certain support activities to actual users.

However, within the audit timeframe, Department billing data was the only information readily available to us that captured usage information. In their response, Department officials also acknowledged that billing data could be used to profile primary users and uses of their computers if the data limitations are considered.



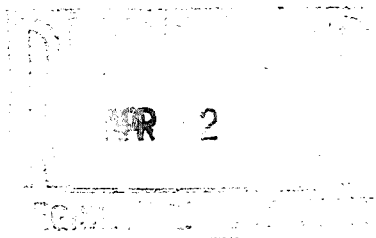
DEPARTMENT OF ADMINISTRATION
State Capitol
Room 263-E
Topeka 66612-1572
(913) 296-3011

Office of the Secretary

Joan Finney, Governor

April 2, 1992

Barbara Hinton
Legislative Post Auditor
Merchants Bank Tower
800 S. W. Jackson, Suite 1200
Topeka, Kansas 66612



Dear Ms. Hinton:

I sincerely appreciate the opportunity to review the draft audit report concerning the capacity and use of the state's mainframe computers. I commend your report, which I found very informative, for its clarity and use of easily understood graphics.

Due to the required technical nature of the Department's response, I include a letter from Jean Turner, Director of DISC, which in detail responds to the report.

I also want to express the Department's appreciation to the Legislative Division of Post Audit's staff for their cooperation during the audit review.

Sincerely,

A handwritten signature in cursive script, reading "Susan M. Seltsam".

Susan M. Seltsam
Secretary

SMS:jp
attach.

STATE OF KANSAS

JOAN FINNEY

Governor



Deputy Director
Administrative Services
(913) 296-3463

DEPARTMENT OF ADMINISTRATION
Division of Information Systems
and Communications

Deputy Director
Information Systems
(913) 296-3463

Deputy Director
Information Resource Management
(913) 296-3463

DIRECTOR
900 S.W. Jackson, 7th Floor
Landon State Office Building
Topeka, Kansas 66612-1275
(913) 296-3463

MEMORANDUM

Deputy Director
Telecommunications
(913) 296-3463

To: Susan Seltsam
Secretary, Department of Administration

Subject: Mainframe Capacity Audit

From: Jean Turner *J. Turner*
Director, DISC

Date: April 2, 1992

We have finished our review of the Legislative Post Audit report on mainframe capacity. Although the audit contains many important insights and observations, there are several areas with which we disagree.

Audit p. 1: In late 1991, Department officials began a \$3 million upgrade to the Unisys mainframe computer officials said would allow it to continue handling the personnel and payroll systems.

Response: Several weeks ago, the auditors asked DISC to provide a breakdown of hardware, software, and maintenance cost for the old and new Unisys systems. The audit, however, shows only the five-year cost for the new system (\$3 million), but it does not show the five-year cost for the old system. In our view, the cost to "upgrade" the Unisys data center should be the difference between the cost of the old system compared to the cost of the new system. Also consideration should be given to the cost to staff and operate both systems. Our analysis shows that the full cost to acquire and operate the new system is \$200,000 less than the cost to keep the old system. This savings occurs because the new system is quite small. Thus, DISC is able to relocate the data center in the Landon State Office Building and save rent expense as well as staffing costs. In addition, the costs to maintain the new system are significantly less.

Audit p. 11: The new computer, a Unisys 2200-423, was installed in February and March 1992. With 32 megabytes of main memory, the new Unisys mainframe is twice as large in that respect as the old machine.

Response: As a point of clarification, Unisys does not manufacture a 2200 system with less than 32 megabytes of main memory. According to Unisys, the larger memory is required to support their most current operating system.

Audit p. 23 (footnote f): The cumulative cost of the Unisys 1100-74 covers almost 12 years and totals about \$5.5 million.

Response: This amount includes only the cost to purchase hardware. It does not include software licenses, installation, hardware maintenance, or software maintenance. In FY 1991 the cost for these items was \$414,530.

Audit p. 13: The pie charts on page 13 and the tables on pages 26 and 27 show very high percentages for system overhead and very low percentages for agency usage.

Response: We believe these charts and tables are not accurate. For example, the audit reports that system overhead on the Amdahl 5890 is 43%. This amount is not correct for a number of reasons. In our review of the data used by the auditors to prepare the Amdahl pie chart we found evidence that the auditors included in system overhead usage for DISC administration, databases, and on-line monitors that more appropriately belongs to agency use. In addition, the Amdahl chart on page 13 and the table in the appendix are based on dollars and not usage. The information comes from DISC's KOMAND billing system. The auditors in their takeoff included dollar amounts charged for using printers, disk storage, tape rental, tape occupancy, and other items not directly related to the use of the central processing unit. According to the footnote on page 26 this takeoff should be based "on the total computer usage" and not on the use of peripheral devices such as tape or print. In contrast, the auditors used CPU seconds to profile the use of the IBM 3084 system. CPU seconds is a more accurate way to profile CPU usage. A similar approach should be used to profile the Amdahl system. Based on an analysis of CPU usage, DISC analyzed systems overhead when DISC accounting applications, data base, and CICS usage is assigned to users. The analysis showed that system overhead is 27.8% instead of 43%.

DISC attempted to confirm the system overhead amount for the IBM 3084. The audit states 73% of the system is used for overhead. This is very high. The auditors calculated this amount based on a review of seven months of data from DISC's VMACCOUNT billing system. Again because we had only three days to respond to the audit, DISC was able only to examine March 1992 data from VMACCOUNT. DISC's review of the March records shows that the overhead in March is considerably less than the amount reported by the auditors for their seven month analysis period. Again, it appears that the auditors included a number of items in overhead that belong more appropriately to agency usage. For example, PROFS, an office automation system, is the major application which runs on the IBM 3084. PROFS includes a number of subsystems that allow agencies to schedule meetings (appointment calendars), send and receive notes (electronic mail), and report information on forms (fast forms). The CPU work required to do this work should be allocated to the users who do calendaring, fast forms, and electronic mail. The auditors have included a significant portion of this work in system overhead. Also, "account set-up" should not appear under system overhead. It should have its own category or be included in the user profiles.

Finally, every day all the user activity in PROFS is backed up. This backup allows DISC to restore user files in the event the system fails. This backup should also be attributed to users since users directly benefit. In the Amdahl 5890 environment users frequently backup their files. DISC charges users when they perform these backups, and the auditors correctly include this backup activity as a "user activity" in their profile of the Amdahl 5890. They should follow the same approach in their IBM 3084 profile. When adjustments like these are taken into account, the system overhead statistic would drop from 73.5% to 50.7%.

Audit p. 26 (footnote a): Usage was determined by reviewing the Department of Administration billing records for each computer for the time period indicated, and the percentage is based on the total computer usage during that time.

Response: Billing data is not highly reliable for the purposes of accounting for "total computer usage" (capacity planning). Vendors of billing software create formulas which are designed to produce a "repeatable" charge. Thus, if a user runs a computer program during peak time or late at night, the reported usage for costing is always the same. In truth, however, the computer works harder during peak time to run programs than it does during times when very few users are on the system. The billing software through its mathematical normalization formulas equalizes the work of the computer in order for the usage to be the same. In addition, different billing software packages have different normalization

formulas and also some packages are not able to account for all the uses of the machine. This is true with KOMAND software which runs on the Amdahl 5890. For example, the software used to "bind" a terminal to the mainframe (called VTAM) runs all the time on the mainframe. KOMAND is not able to capture the CPU cycles used to run VTAM. There are many other software packages like VTAM that are not captured. Thus, statistics in the KOMAND billing data will not reflect any usage for these packages. DISC knows how much machine work is done by VTAM through the use of other non-billing packages called monitors. Since monitors use a different approach to counting usage, it is unwise to combine monitor data with billing data.

Nonetheless, billing data can be effectively used to profile users if the analyst is willing to accept the limitations of the data. As I previously mentioned, billing software is designed to produce a repeatable charge and not designed to account for all the resources used to perform system overhead or to account for all the activities of users. DISC works very closely with the vendors of billing software to improve the vendor's ability to account for as much usage as possible. Also, DISC has designed special in-house routines to try to capture usage for billing. For example, at the present time DISC technicians are finishing a project to capture VTAM billing records.

I appreciate the opportunity to respond to the audit. Please let me know if you require any additional information.



Information Systems

Landon State Office Building, 900 S.W. Jackson #603-N
Topeka, Kansas 66612-1276
913-296-5042 --- 913-296-0008 (Fax)

Joan Finney, Governor

~~Michael Johnston, Secretary~~
Joe Dick, Secretary

April 2, 1992

Ms. Mary Beth Green
Legislative Post Auditor
800 SW Jackson, Suite 1200
Topeka, Kansas 66603

Dear Ms. Green:

The following are the changes that I requested by phone that you make to the draft copy of the performance audit report "Reviewing the Capacity and Use of the State's Mainframe Computer."

Page 6, & 22 - (Major Uses)

Unemployment Insurance Payments, Employer Contributions, Job Service Programs, and all other various support systems.

Page 16 - (Last Paragraph - Last Sentence)

In addition, because it can take two to three years to complete the grant application process and acquire a new mainframe, Human Resources' Staff indicated they must practice long-range planning to ensure they have adequate mainframe capacity to meet changes in workload and use.

Thank you for your help and assistance in making these minor changes.

Sincerely,

A handwritten signature in cursive script that reads "James A. Cantrell".

James A. Cantrell
Computer Operations Manager

JAC:dr

cc: Robert E. Molander
Director of Staff Services



STATE OF KANSAS

DEPARTMENT OF SOCIAL AND REHABILITATION SERVICES

915 S.W. Harrison, Docking State Office Building, Topeka, Kansas 66612-1570

JOAN FINNEY, Governor

April 1, 1992

Barbara J. Hinton
Legislative Post Audit
Merchants Bank Tower
800 S.W. Jackson, Suite 1200
Topeka, KS. 66612-2212

Dear Ms. Hinton:

I would like to thank you for giving SRS an opportunity to review the draft on mainframe computer capacity. Overall, we feel the report accurately reflects Social and Rehabilitation Services mainframe capacity. Also, we feel you did a good job of explaining how excess capacity is needed for growth as new applications are added.

Our experience has shown any time the average CPU usage gets above 80%, severe performance problems result. To ensure good performance, SRS feels an average CPU usage should remain below 70%. An average between 70% - 80% is marginal and will have periods of unacceptable performance. CPU averages must be kept low enough to handle peak periods effectively.

I would like to see your audit mention hours of operations. SRS has operations staff on duty from 3:30 p.m. Sunday through 12:00 a.m. Saturday. We also have a shift between 3:30 p.m. Saturday and 12:00 a.m. Sunday. On Sundays from 6:00 a.m. to 12:00 p.m. the 3090 is down for maintenance. Sometimes we make the computer system available to field staff on Saturday mornings. When operational staff are not on duty, we load the 3090 with long running batch jobs that do not require operator presence.

I would like to compliment you on the use of pictures and good explanations in the report. If you need any additional information or clarification, please don't hesitate to call.

sincerely,

Donna Whiteman
Secretary

DW:dbr