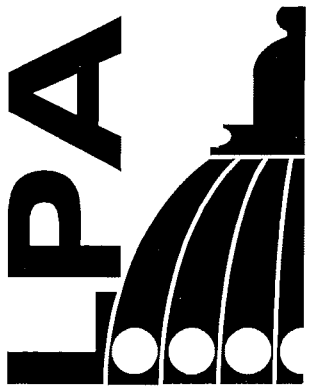

PERFORMANCE AUDIT REPORT

Computer Capacity and Utilization at the Division of Information Systems and Computing

A Report to the Legislative Post Audit Committee
By the Legislative Division of Post Audit
State of Kansas
March 1983

83-49

Legislative Post Audit Committee
Legislative Division of Post Audit

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COMPUTER CAPACITY AND UTILIZATION AT THE DIVISION OF INFORMATION SYSTEMS AND COMPUTING

At its March 28, 1983 meeting, the Legislative Post Audit Committee directed the Legislative Division of Post Audit to conduct a limited-scope audit of the Division of Information Systems and Computing. The purpose of the audit was to answer several specific questions asked by a House Ways and Means subcommittee concerning the Division's current computer capacity and utilization, the feasibility of better utilizing the computers at nights and on weekends, and the accuracy of projected development hours for new systems. Each of the subcommittee's questions is answered below.

Is Data On Projected Computer Utilization In The Division's Comprehensive Plan Accurate?

To assess the accuracy of data on computer utilization in the State plan, the auditors interviewed Division officials to determine how utilization was estimated. Then they compared projections of future utilization in the plan to actual utilization to determine how accurate the projections were.

The comprehensive plan states that utilization of the IBM 3033 computer in fiscal year 1982 was 44 percent of capacity for the central processing unit, 82 percent for main memory, and 66 percent for input/output capacity. The plan projected that the IBM central processing unit would be fully utilized in fiscal year 1985, main memory would be fully utilized in fiscal year 1983, and input/output capacity would be fully utilized in fiscal year 1984. New memory capacity was added to the system in early fiscal year 1983 to avoid running out of capacity. New projections of when this additional memory capacity will be fully utilized have not been completed.

The Division made its IBM utilization projections by analyzing nine months of utilization data for fiscal year 1982. The usage of the computer by its six largest users was computed in terms of their number of transactions to and from the computer. Projections of increased transactions by the six agencies were then used to estimate total system utilization for fiscal years 1983 and 1984. Projections for fiscal year 1985 and 1986 were based on the assumption that utilization would increase at a steady rate.

For the Univac system, the comprehensive plan estimated that the Univac central processing unit was being utilized at 60 to 70 percent of capacity, based on analysis of six months of data. Also, the plan indicates input/output capacity was nearing overutilization. Because the Univac system does not provide as much utilization data about itself as the IBM, and because of the Division's short period of experience with the Univac, precise projections of future utilization were not made. However, the Division determined that because the system is close to being utilized at capacity now, implementation of the final stages of the Kansas Integrated Personnel and Payroll System will cause the system to be overloaded in the near future.

Data collected by the auditors appears in general to substantiate the Division's statements that both systems are nearing capacity at times of peak

usage. For example, the plan states that average IBM central processer utilization from 9 a.m. to 4 p.m. will reach 66 percent in fiscal year 1983. (Since this percentage does not represent peak usage but is instead an average, 80 percent is considered capacity by the Division.) The auditors' data for the third quarter of fiscal year 1983 shows the average for peak hours of utilization to be 75 percent, indicating the IBM system is nearing capacity utilization at times of peak usage as predicted in the plan. In the Univac system, the comprehensive plan said utilization of the central processing unit was between 60 and 70 percent in early fiscal year 1983. Data collected by the auditors for April 1983 indicated the system was 86 percent utilized at peak periods and 76 percent on average during the day. This and other data reviewed by the auditors suggest that utilization of the Univac will exceed capacity as new uses for the system are added, which again is consistent with the conclusions of the plan.

The auditors concluded that data on current and projected utilization of the computers in the comprehensive plan and the methods of deriving that data appear to be reasonable. However, those projections cannot be considered to be precise. Their accuracy is limited by the lack of complete information about utilization generated by the computers, particularly the Univac, and by the varying quality and specificity of data from user agencies on future computer usage on which the projections depend.

Will the Recommended Elimination of Five System Development Projects Reduce the Need For New Computer Hardware?

Another concern about data in the comprehensive plan was whether or not the elimination of five new projects as recommended by a subcommittee of the House Ways and Means Committee would significantly change the utilization projections in the plan and the need for additional hardware. The auditors concluded the elimination of those projects would not significantly alter utilization projections or the need for new hardware. They calculated that the one project to run on the IBM computer, the telecommunications management information system, would comprise only about .2 percent of total transactions of data to and from the computer. The other four projects, including upgrades to the State accounting system and a skills inventory system for the Division of Personnel, would run on the Univac system and would comprise only about 2.5 percent of total transactions to and from that system. These projects are too small to have much of an impact.

What Is the IBM Computer Center Utilization At Different Time Periods?

The auditors analyzed available data to determine the utilization of the IBM's central processing unit, main memory, and input/output capacity for three time periods during each weekday from January 3 to March 31, 1983. The central processing unit performs required manipulation of data to create the desired output. Data on the central processing unit's average utilization was available on an hour by hour basis expressed as a percentage of total capacity. Main memory is the computer's ability to store information for immediate use by the central processing unit. Data on main memory utilization was available

on an hour by hour basis expressed as an average "paging rate" per second. Paging is the ability of the system to move information in and out of main memory as needed by the central processing unit. Data on input/output capacity is not kept by the Division on an hour by hour basis, although average utilization data from 9 a.m. to 4 p.m. is available. Division officials said they expect the pattern of usage for input/output at different times of the day would be similar to the pattern for memory and central processing unit usage.

The auditors divided the day into three periods--day, evening, and night. Within each period, they found the hour with the highest utilization each day. They then took an average of these peak hours for the entire period. The results are shown in the table below.

Peak IBM Utilization

	Central Processing Unit (a)	Memory (paging)(b)
7 a.m. - 5 p.m.	75%	98%
5 p.m. - 12 a.m.	44%	4%
12 a.m. - 7 a.m.	16%	3%

(a) One-hundred percent is complete utilization of the central processing unit. For this table, 80 percent is considered effectively to be complete utilization since these figures do not show peaks within an hour, but represent only the average utilization for the hour.

(b) One-hundred pages per second is considered 100 percent utilization of capacity. These percentages represent a percentage of 100 pages per second.

The table shows peak usage of the IBM is at or near capacity during the 7 a.m. to 5 p.m. time period during the week. Utilization of the computer fluctuates during the peak hours from 7 a.m. to 5 p.m. Peak utilization generally occurs between the hours of 10 a.m. and 4 p.m. Utilization during the day is lowest from 7 a.m. to 8 a.m.--peaking at 53 percent in one week examined--and from 4 p.m. to 5 p.m.--when utilization peaked at 66 percent in one week. Considerably more unused capacity is available at night, particularly from 12 a.m. to 7 a.m. Graphs which provide more detail on utilization are available upon request. Data on weekend utilization is not kept by the Division, but Division officials indicated that weekend utilization would appear very low if measured.

The preceding discussion of IBM utilization focuses only on the IBM 3033 computer. The Division also uses a relatively small IBM-compatible computer, the NAS 5000. The NAS 5000 is not used for on-line applications which create the largest demand on computer resources. On-line applications are those where the computer immediately provides requested information on a screen. The comprehensive plan indicates the NAS 5000 is utilized somewhat less than the IBM 3033. However, it does not appear feasible to shift work from the IBM 3033 to the NAS 5000. The reason is the IBM 3033 is a much larger machine and processes information about three times faster than the NAS 5000. Division officials indicated that moving any one of the five on-line software

systems to the NAS 5000 would overwhelm that computer's capacity and computer response time would be unacceptably slow. Other technical problems with a transfer of work to the NAS 5000 add to the conclusion that the NAS 5000 does not provide an answer to the IBM capacity problem.

What Is the Univac Computer Utilization At Different Time Periods?

Hour by hour utilization data was not available for the Univac as it was for the IBM. Data on utilization of the central processing unit was produced for the auditors by running a special program for a week in April 1983 during the hours of 9 to 10 a.m., 1 to 3 p.m., 8 to 9 p.m., and 2 to 3 a.m. The following chart shows the results of those special computer runs.

Univac Central Processor Utilization

Time Period	Average Utilization
9 to 10 a.m. and 1 to 3 p.m.	76%
8 - 9 p.m.	48%
2 - 3 a.m.	24%
Weekends	8-21%

The table shows that, similar to the IBM, the Univac central processing unit is nearly fully utilized during the weekdays and is less utilized at night and on weekends. There is data on input/output and memory utilization for the Univac, but it is not as useful as a measure of system utilization as it was for the IBM system. The Division's comprehensive plan does not provide detailed information on memory and input/output utilization for the Univac computer. Data on utilization of main memory analyzed by the auditors shows that a high percentage of main memory is in use even when central processing unit utilization is low. The reason for this is that the Univac draws data into main memory from disks up to memory's capacity at most times in order to do even small jobs as quickly as possible. Similarly, data on input/output utilization shows delays in moving information in and out of the central processing unit both day and night, indicating that the central processing unit uses input/output capacity as fast as it can even when utilization of the central processing unit is low.

To What Extent Is It Feasible To Shift Use of The Computers From Days to Nights and Avoid or Delay Equipment Acquisitions?

To answer this question, the auditors interviewed the largest users of the IBM and Univac computers to determine if these users could shift their use of the computers from days to nights. The auditors discussed 63 computer

applications with the Departments of Revenue, Transportation, Social and Rehabilitation Services, Health and Environment, Education, and Administration. These applications represent roughly 80 percent of the IBM's workload and 90 percent of the Univac's workload. The auditors' findings concerning both batch and on-line uses of the computers are presented below. Batch work involves asking the computer to do a job and returning later to see the results on a screen or paper copy. On-line work involves asking the computer to do work and immediately getting an answer back on the computer screen.

Many Batch Jobs Could Be Moved To Nights But the Impact on Computer Utilization Would Be Slight

The auditors found that all 63 applications included some batch processing, including updating files with new information and printing reports. Of the 63 applications, 29 (46 percent) included batch jobs that were typically run during the day when usage of the computers is at its peak. Eleven of those jobs are done during the day for specific reasons. For example, the Department of Revenue has listings of each morning's deposits printed in early afternoon so that deposits can be made immediately and the maximum possible interest earned. The remaining 18 day jobs primarily involve printing reports during the day for convenience, but they could be printed at night without causing inefficiency.

Although it would be possible to run many batch jobs at night that are now run during the day, switching those jobs to nights would do little to solve the computers' capacity problems. The reason is that the Division's computers have been set up so that on-line jobs will always run before batch jobs. At times of the day when on-line processing reaches its peak, batch processing automatically slows or stops. Thus, batch processing and printing only occur during the day during times when the computers are not fully occupied with on-line work.

Some On-Line Jobs Could Be Moved To Nights If Data Entry Personnel Could Be Hired for Night Shifts

On-line processing consumes most of the computers' capacity during peak periods of the day. The auditors found that 28 of the 63 applications reviewed included some on-line jobs and all of those on-line jobs were done primarily during the day. Most of these daytime jobs, 21 or 75 percent, are done during the day for clear reasons. For example, the Kansas Integrated Personnel and Payroll system allows on-line data entry of personnel information by most State agencies. It is unlikely any one agency would have enough personnel activity to justify hiring someone to enter personnel data at night. Also, this and many other on-line systems were designed to improve efficiency by providing immediate information to users during the day. Nevertheless, the auditors found seven on-line applications that could be done at night without adversely effecting an agency's performance. All of these applications are in the Departments of Revenue and Social and Rehabilitation Services.

Concentrating on the Department of Revenue because it is a larger user of computer resources, the auditors found that data is entered during the day and night to support the drivers license, income tax, and sales tax applications. There would be little or no effect on the Department's ability to do its job if all

data entry for these applications was done at night. Moving this data entry to nights would decrease the peak daytime usage of the IBM computer. These applications are large and the auditors estimate they consume roughly 10 percent of the IBM's capacity during the day at peak times of the year for these applications. Thus, it is possible to move some on-line applications to nights and decrease usage of the IBM computer during the day to a limited extent. However, two factors make even this limited decrease in daytime usage difficult to accomplish.

--First, officials at both the Departments of Revenue and Social and Rehabilitation Services told the auditors it would be difficult to find enough people willing to work nights to dramatically increase nighttime data entry. The Department of Revenue currently does some data entry at night and has trouble hiring and retaining people for available positions.

--Second, the Division of Information Systems and Computing has no formal mechanism or clear authority to force the Department to enter data at night. The Division could encourage nighttime data entry by increasing the current 14 percent discount for night processing. A dramatic increase in that discount, however, would result in higher daytime rates.

Are the Projected Hours Needed to Develop New Computer Applications Shown In the Division's Comprehensive Plan Accurate?

The Division's comprehensive plan lists the hours needed to develop programs for new or enhanced computer applications. The hours listed in the plan appear as if they were precise projections of development hours. To determine if those projections are accurate, the auditors interviewed the Division officials responsible for them. They told the auditors the numbers for development hours were not intended to be precise projections, but are instead rough estimates intended only to indicate the comparative scope of the projects.

The rough estimates were derived by grouping the projects into small, medium, and large categories. The estimate for each project was then adjusted based on the staff's experience with similar projects in the past. Estimates for projects after fiscal year 1983 are particularly rough since detailed definition of those applications has not begun. The auditors had planned to compare previous projections of development hours to actual hours to assess the accuracy of the estimating process. This task was not done because the auditors learned the plan represented the first time the Division had attempted to project development hours in advance of detailed definition of the system. Thus, no historical record existed to be checked.