DP-MS-73-47

CONF-731023--1

SAVANNAH RIVER POST INSTALLATION REVIEW SYSTEM/360 MODEL 195K

by

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Proposed for presentation at the AESOP IX Meeting, to be held in San Francisco, CA in October 1973.

This paper was prepared in connection with work under Contract No. AT(07-2)-1 with the U. S. Atomic Energy Commission.

SAVANNAH RIVER
POST INSTALLATION REVIEW
SYSTEM/360 MODEL 195K

INTRODUCTION

The S/360-195K was installed in September 1972 to replace the S/360-65J Multiprocessor which had been in use since November 1969. Eight months operation with the new system indicates that the S/360-195 satisfactorily meets requirements as discussed in the 1970 procurement studies.

DISCUSSION

A. INSTALLATION OF NEW SYSTEM

Installation of the S/360-195 was carried out in two stages. During the first stage, Du Pont Construction performed required floor panel modifications and installed the motor-generator set and IBM installed cables and performed stand-alone checkout on new direct access storage and peripheral devices. This pre-CPU stage required three normal five day work weeks. The CPU installation stage required several teams of IBM personnel from the factory and other locations for approximately 2-1/2 weeks on a continuous round-the-clock basis. The S/360-65MP operation was not significantly affected until the 15th day of this phase when one of the 2860 Selector Channels was removed and modified for use on the 195. All installation operations followed the planned schedule very closely and the system was turned over to Du Pont on September 15, 1972.

B. SYSTEM OPERATION

In general the new system has performed well. The only major problem has been with the motor generator set which supplies the 415 cycle power for the core storage and central processing units. Failures in the MG set voltage control panel printed circuit boards were occuring approximately once per month from the time of installation. This problem was solved in March 1973 by replacing the control wiring which runs between the MG set and computer room and relocating the voltage control panel circuit boards to an air conditioned location.

Unscheduled maintenance downtime hours on the central computing system since July 1968 are shown on Figure 1. The high periods of unscheduled maintenance shown for the 195 were all associated with motor generator problems. Unscheduled IBM maintenance for other problems required a total of one hour during the months of March and April.

C. SYSTEM CAPACITY

Development of system specifications which ultimately led to the selection of the S/360-195 was preceded by various studies in which the characteristics and magnitude of the workload for a five year period were evaluated for various computer configurations. Figure 2 provides the estimate of the projected workload in S/360-65 serial processing hours that was provided to interested computer system vendors in the June 1971 pre-proposal conference. This projection indicated that the workload, if highly CPU bound, would expand for the first two years to about 5000 S/360-65 serial processing hours with subsequent growth dependent upon capability to increase the systems capacity through operating system and software improvements, performance analysis techniques and hardware additions.

Figure 3 illustrates the growth in our total estimated workload since installation of the 195. During the first two quarters of operation an estimated average of 2200 hours of equivalent S/360-65 work has been processed each month in an average of 410 production hours on the S/360-195. In the first three quarters of 1972 an average of 834 hours of serial work was processed per month in 522 hours of S/360-65 production time. (Multiprogramming efficiencies permitted 1.6 hours of serial work to be performed during each production hour of operation on the S/360-65). Based upon these estimates, approximately 2.6 times as much work is being performed on the 195 in 80% of the operating time on a three shift basis. The greatest improvement has been observed on the day shift. For the same time periods used above, approximately 4.3 times as much work is being performed during the 195 day shift in 10% fewer operating hours as was processed on the MP65. Relative throughput rates for the day shift are more indicative of the capacity of the S/360-195 since to date that shift is the only period when there is an adequate amount of work to provide for efficient multiprogramming. Based upon the observed workload it appears that the 195 has adequate capacity to handle between four and five thousand hours of S/360-65 serial work per month with a moderate amount of overtime. The variation in capacity limits is dependent upon the workload; the upper limit assumes that future jobs will be more CPU bound than the current workload while the lower limit assumed the CPU/IO ratio for additional work will be similar to the current workload.

Figure 4 indicates the characteristics of the current workload as compared to the actual workload which was run on the S/360-65 in the second quarter of 1970 and the long range workload which was projected for the proposed system. The difference between the current workload (1 Qtr. 73) and projected workload reflects the fact that all the projected physics modules are not yet operational and burn-up and safety studies are in design and testing stage.

The growth in jobs processed is illustrated in Figure 5. Approximately 15000 jobs are now being processed per month as compared to 11000 jobs/month for the MP65. The number of jobs processed on the day shift alone is now about equal to the previous total for all shifts.

The increased CPU power is reflected in the drop in the number of long running jobs as shown in Figure 6. These are jobs with CPU times greater than 30 or 60 minutes. Jobs that require over one hour on the 195 would probably run 12 hours or more on the S/360-65, if they could be run at all.

Figure 7 indicates how the faster CPU and I/O times on the new system have affected the mean job times. CPU time has dropped from in excess of 150 seconds/job to 50 seconds/job and total time has dropped from 250 seconds to 115 seconds/job.

The distribution of CPU time per job has shifted as indicated in Figure 8. As illustrated, 75% of all jobs now require less than 10 seconds CPU time as compared to 40% of the S/360-65 jobs. Ninety percent of all 195 jobs now require less than one CPU minute.

The affect of the additional system power on job turnaround time is indicated in Figure 9. Job turnaround time, which is the difference between job submission time and the time that job output was returned to the users box, was recorded for jobs submitted through our main input stream in technical laboratory (773-A) during three typical day shifts; the April 72 date was during the time the MP65 was fully loaded; October 72 was shortly after the S/360-195 was installed, and April 73 was after the workload had grown to its present level. Sixty-five percent, or 624, of the jobs processed were most recently being returned to the user within 30 minutes of submission. This represents 8% more jobs than were processed during the entire day in the April 72 evaluation.

Figure 10 lists the current direct access usage and compares it with the design criteria. The fixed head drums are used currently for the primary system resident, a backup resident device and the high use libraries. This amounts to 66% of the available space. Future plans consider using the remainder for user work areas or in conjunction with the JOSHUA system to improve terminal response time. The large capacity 3330 disks are about 64% of the design level.

The 2314 units were not part of the 195 acquisition but were carfied over from the multiprocessor system. The 2314 disks packs are made available to users who have need of direct access space with the greatest use now being for scratch space.

SUMMARY

The overall performance of the computer hardware and software has been excellent. The planning was performed so that the installation was on schedule and with only minor problems.

One unpredicted item was the higher than anticipated CPU utilization. CPU utilization is currently 70% on the day shift and frequently as high as 90% on the evening shift. These high figures occur because the programs did not become as I/O bound as predicted (because of more actual calculating in the jobs and better I/O performance from the new direct access devices). Also, more jobs are concurrently executing. As job sizes increase a decrease can be expected in CPU utilization. Also unpredicted was the poor performance of the motor generator and high uptime from the IBM hardware.

The system has demonstrated its capability of handling our work and the current programmatic needs of the Laboratory. The projection which we made over two years ago is proving to date to be accurate.

PRK:vmc
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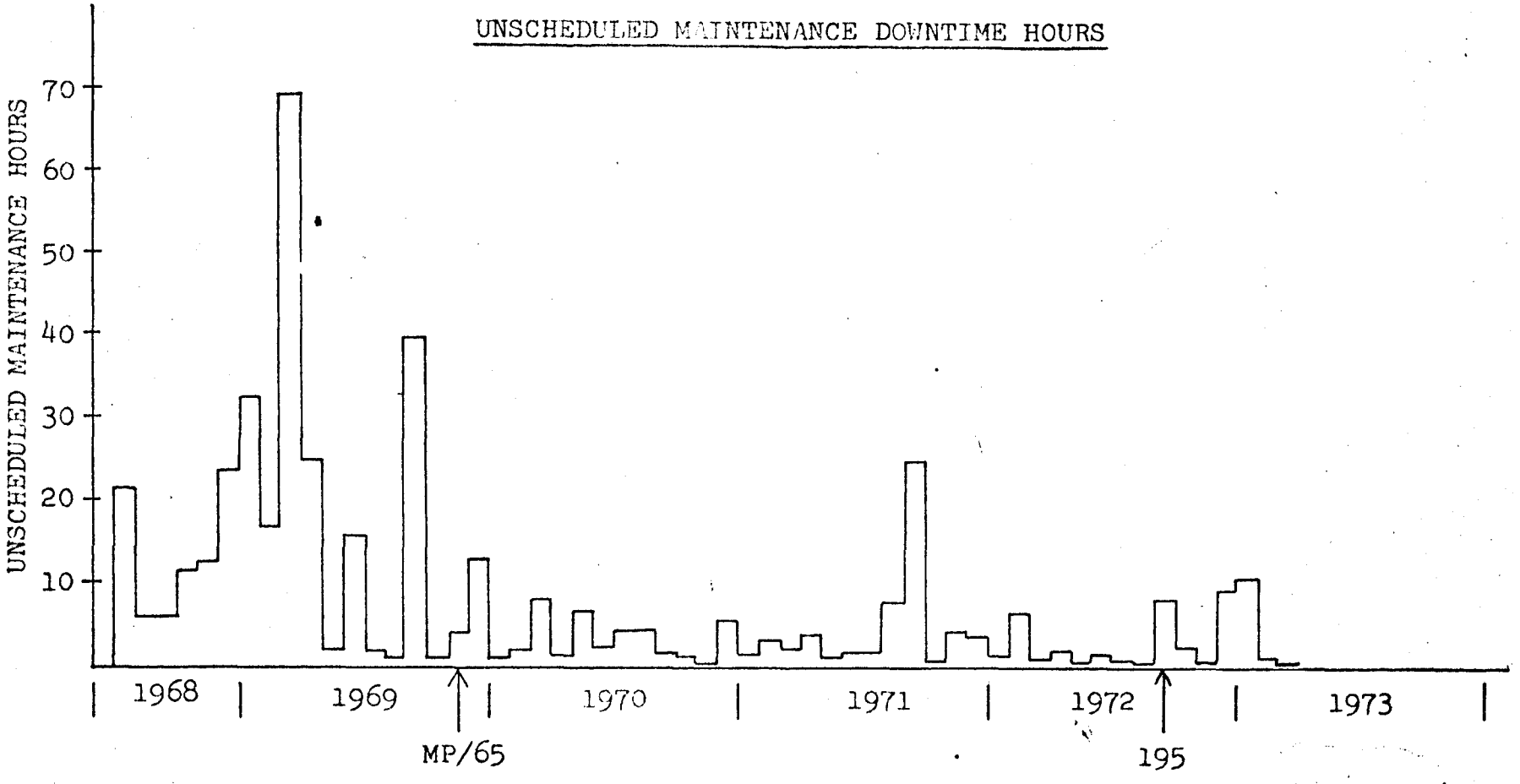
UNSCHEDULED MAINTENANCE DOWNTIME HOURS
UNSCHEDULED MAINTENANCE HOURS
70
60
50
40
30
20
10
1968
1969
1970
1971
1972
1973
MP/65
195

FIGURE 2

PROJECTED WORKLOAD GROWTH
(In S/360-65 Serial Processing Hours)

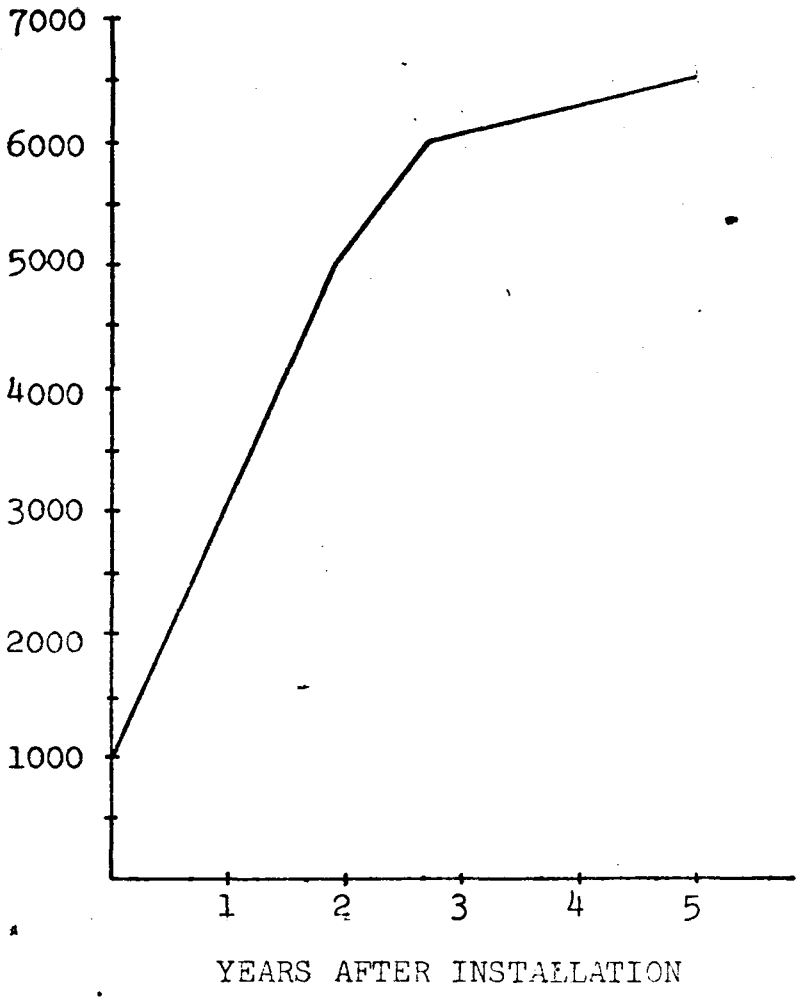

FIGURE 3

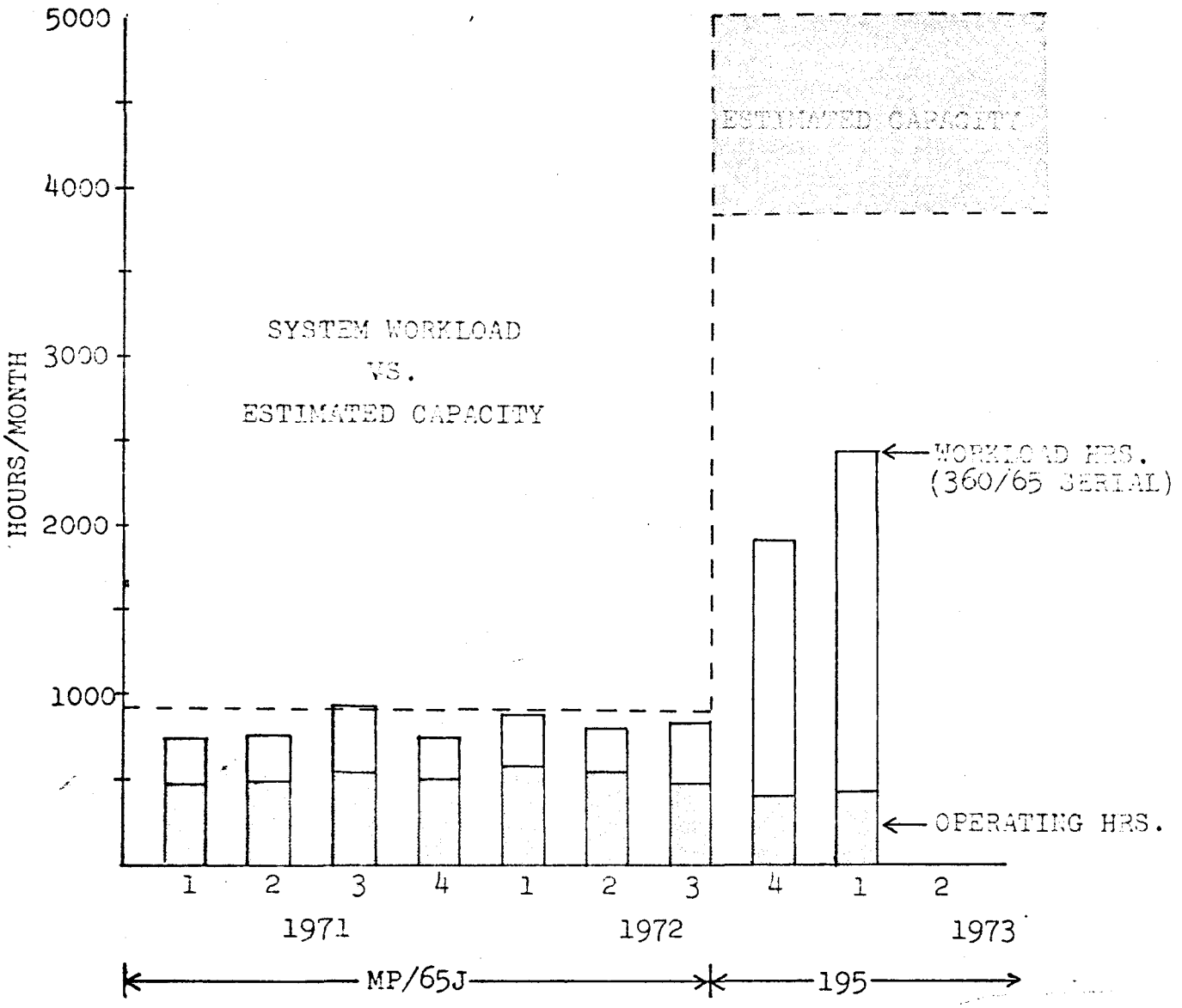
5000
4000
3000
2000
1000
HOURS/MONTH
SYSTEM WORKLOAD
VS.
ESTIMATED CAPACITY
ESTIMATED CAPACITY
WORKLOAD HRS.
(360/65 SERIAL)
OPERATING HRS.
1
2
3
4
1
2
3
4
1
2
1971
1972
1973
MP/65J
195

FIGURE 4

WORKLOAD

	S/360-65	S/360-195	
	2 QTR. 70	1 QTR. 73	PROJECTED
STEPS/MO.	25,000	35,350	50,000
CPU WORKLOAD (65)			
HRS./MO.	450	2,029	3000-5000
MIN./STEP	1.0	3.5	3.6 - 6.6
AVG. K/STEP			
UNWEIGHTED	150	182	560
WEIGHTED	-	277	500

FIGURE 5

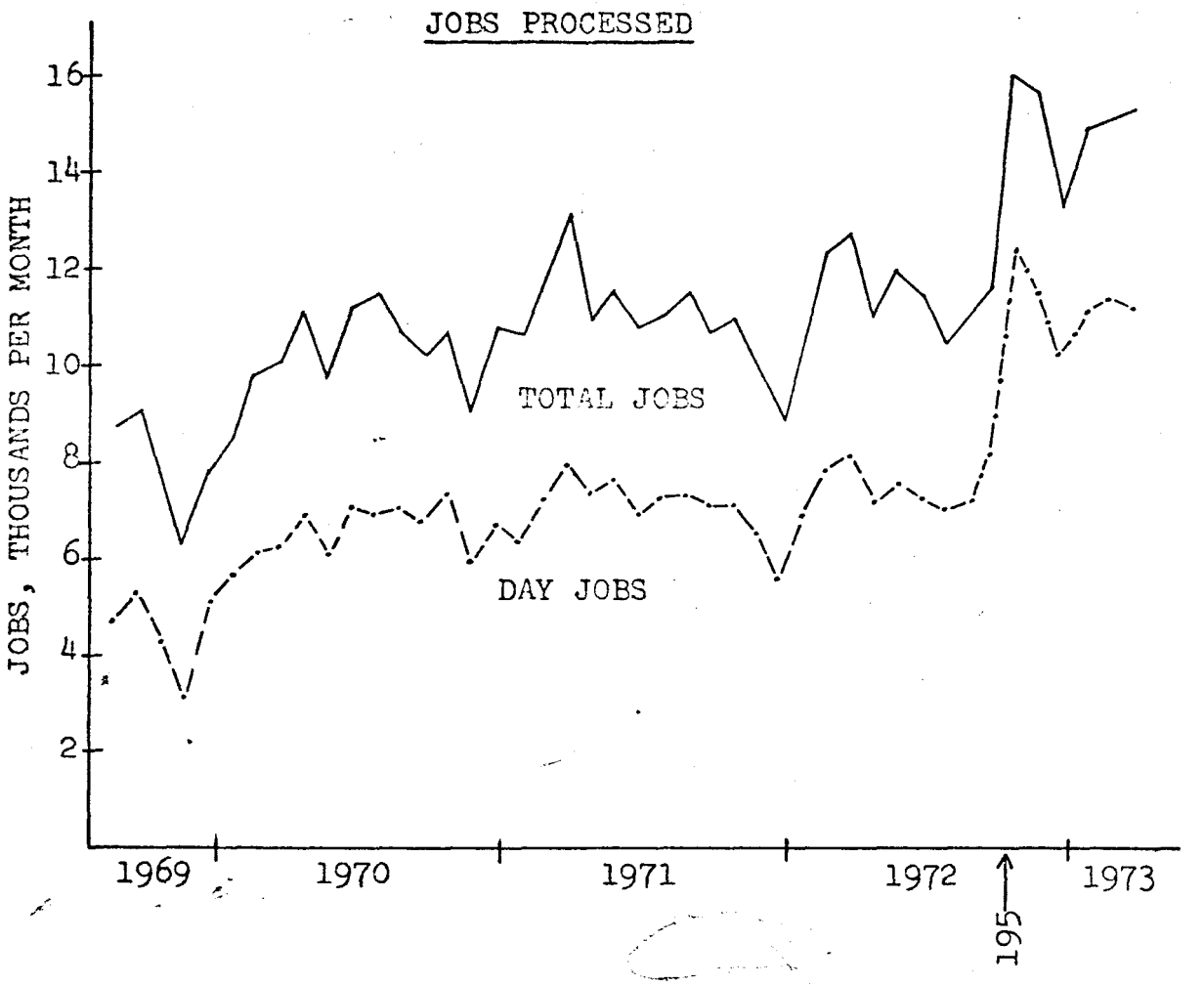
JOBS PROCESSED
JOBS, THOUSANDS PER MONTH
16
14
12
10
8
6
4
2
TOTAL JOBS
DAY JOBS
1969
1970
1971
1972
1973
195

FIGURE 6

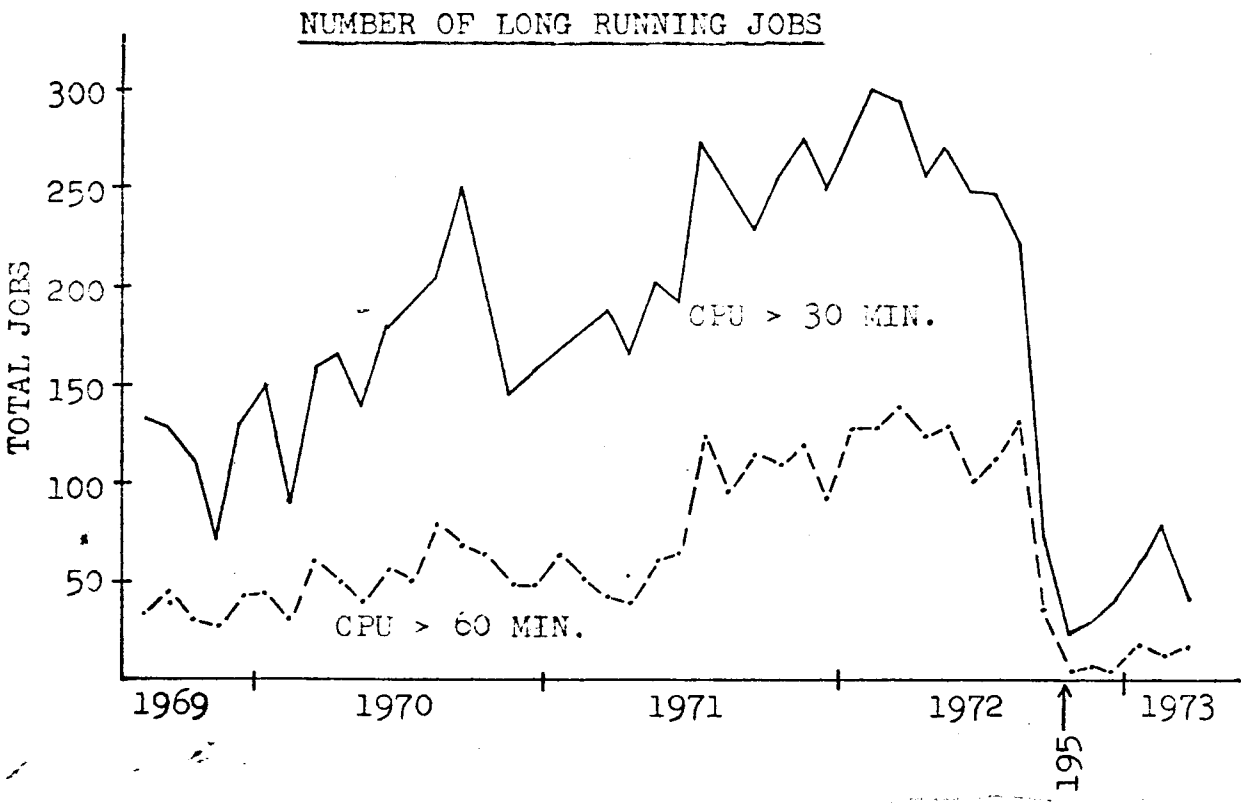
NUMBER OF LONG RUNNING JOBS
TOTAL JOBS
300
250
200
150
100
50
CPU > 30 MIN.
CPU > 60 MIN.
1969
1970
1971
1972
1973
195

FIGURE 7

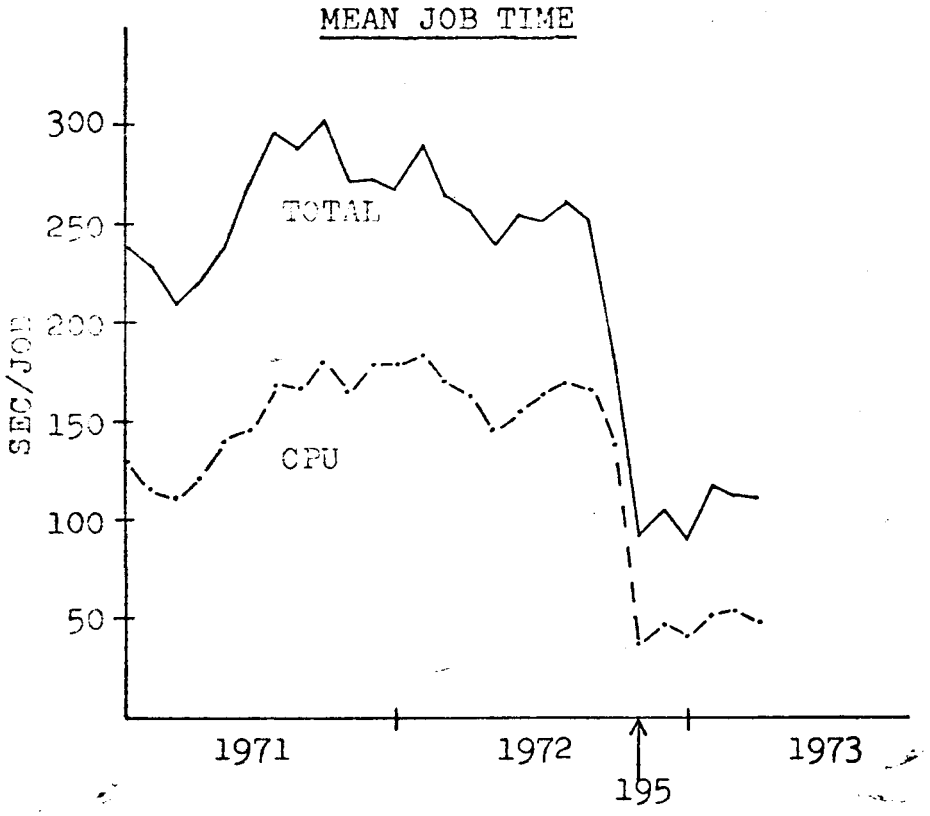
MEAN JOB TIME
300
250
200
150
100
50
SEC/JOB
TOTAL
CPU
1971
1972
1973
195

FIGURE 8

CPU TIME DISTRIBUTION

Q1 '72 VS. Q1 '73

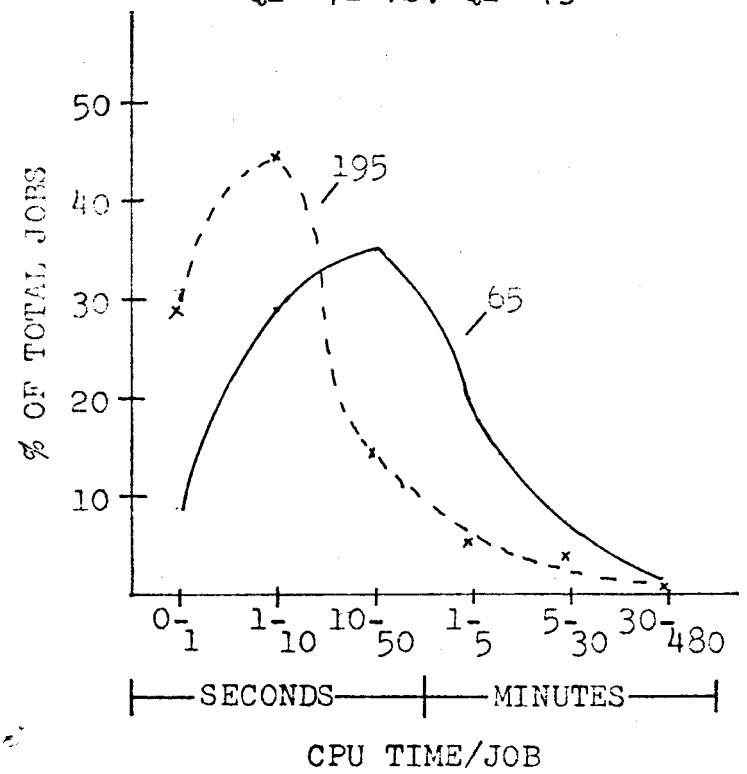

FIGURE 9

JOB TURNAROUND

TURNAROUND, MINUTES	% OF JOBS SUBMITTED 4/72	10/72	4/73
1 - 30	33	80	65
31 - 60	38	15	20
61 - 90	17	3	9
91 - 120	6	1	3
121 - 180	4	1	1
181 - OVER	2	0	2
NUMBER JOBS	579	832	961

FIGURE 10

DIRECT ACCESS DEVICE USAGE (5/73)

° FIXED HEAD DRUMS 27.9×10^6 BYTE CAPACITY

USAGE	AMOUNT USED
SYSTEM	66%

° MOVABLE HEAD DISKS

- 3330 16 UNITS 1600×10^6 BYTE CAPACITY

USAGE	DESIGN	CURRENT	AMOUNT USED
SYSTEM	1	1	100%
SPOOL	1	1	50%
PRODUCTION	1	1	50%
USER	2	1	40%
JOSHUA	4	3	60%
CLASSIFIED	1	0	
SCRATCH	2	2	100%
BACKUP	1	0	
MOUNTABLE	3	3	100%
	16	12	64%

- 2314 16 Units 466.8×10^6 BYTE CAPACITY

USAGE	CURRENT
SYSTEM	2
USERS	3
PRODUCTION	4
JOSHUA	1
SCRATCH	6