Information Systems
Capacity Planning

Monthly Report
NOV 87

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Capacity Planning Monthly Report - November, 1987

This issue of the "Capacity Planning Monthly Report"
contains information current through November, 1987.

It should be filed in your Capacity Planning notebook.

Dave Morton
December, 1987

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Capacity Planning Monthly Report

Distribution

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INTRODUCTION

Purpose

The purpose of this report is to understand where we are and where we're going in our use of the mainframe computer, so that timely and appropriate steps can be taken on behalf of capacity, if required.

It is intended, also, to encourage the efficient use of computer resources, so that the capacity of the computer can be used effectively to avoid or postpone expensive upgrades.

Scope

Past and present:
The first step in forecasting the future workload is to understand the past and present workload. Consequently, there is an emphasis on history and analysis, made more understandable through graphics.

Forecasting the future:
We currently do not have specialized software to perform forcasting or workload modeling. Therefore, until such tools are available, we will estimate forecasts manually using whatever techniques we can devise.

The forecasting tool used here in most cases is SAS/GRAPH, where the growth rates are based on past growth rates. This method has proven to be surprisingly accurate.

Why Peaks Are Measured

Peak periods of computer activity are measured and reported because they represent the highest demands (or loads) placed on the computer, and are the primary indicators of remaining capacity.
Peaks are sometimes referred to as "high-water marks."

"Daytime" peaks are usually the highest since so many people interact with the computer system during that timeframe.

Averages and "non-daytime" measurements are also reported (where useful) in order to characterize the workload and highlight opportunities for shifting the work to other time periods.

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ISSUES

1. **CPU Power:**
   More CPU power is needed from time to time on all shifts except the Weekend shift. The CPU is often maxed-out for for hours at a time during Prime, Evening and Night shifts.

   While average CPU utilizations for a week or a month may range from 55% to 85% busy per shift, much higher utilizations for several hours at a time are common.

   Online response times and batch job run times will both take longer in the future.

   A faster CPU (or multiple CPUs) will cure the problem.

2. **Memory/Paging:**
   Without an increase in memory, Paging will continue to increase on Prime shift.

   Paging is non-productive work which elongates online response times and batch job run times.

   Therefore, online response times during the day will deteriorate, and daytime batch jobs will take longer to run.

   Additional memory will cure the problem.

   MVS/XA:
   Memory size will also be a problem with MVS/XA, which will use about 1.5 additional megabytes of memory. Implementation of MVS/XA is planned for March, 1988, but should probably NOT be attempted without more memory.

3. **Channel Usage (Tapes):**
   Channel usage for tapes continues to climb, slowing down tape jobs, at times.

   The tape channels are about 50% busy during the evening shift, as a monthly average. However, channel utilization sometimes reaches 95% for an hour, lengthening the run times of all tape jobs during that hour.

   Adding a tape controller (using available channels) will cure the problem,

4. **Tape Drives:**
   We sometimes don't have enough available tape drives to run Production jobs, according to the computer operators. A lack of tape drives will cause delays in Production, from time to time.

   Additional tape drives will cure the problem.

5. **Computer Room Space:**
   Computer room space is tight.
   A lack of computer room space may delay or prevent the acquisition of some equipment.

6. **Production Deadlines:**
   Some Production batch jobs will be completed after their deadlines, and some online files will continue to be late in their availability.

   Hardware upgrades and additions will cure the problem.

7. **Declining CPU Growth Rate:**
   The growth rate in our CPU usage has declined over the past 12 months.
   Our annual, average growth rate since 4Q85 has been an extremely high 40%.
   Our current growth rate, based on the last 3 months, is only 13% annually. This is good, but it may change.

8. **Statistical Processing:**
   Due to the implementation of statistical processing, and other reasons, run times for some batch jobs are causing serious delays.

   Many improvements have been made to the jobs and programs, but they are not enough to reduce run times to acceptable durations.

   One AP job had its runtime cut by 50% through programming and JCL changes, but it may double in execution time with statistical processing.

9. **DataPacker:**
   The DataPacker product is saving considerable amounts of disk space.

   As of November 10th, about 1.6 boxes of 3380 disk (single-density disk) have been freed for other uses.
   This is 5800 cylinders, or 6.5 disk packs freed by DataPacker.

10. **Disk Space:**
    Disk space has been tight despite the 5800 cylinders freed by the DataPacker product.
    (Operations Support monitors disk space, and is in daily contact with disk space requirements).

Recommendations

1. **Memory Upgrade:**
   Add 8 megabytes of memory to the mainframe this Fall, raising memory to 32 megabytes from 24 megabytes.

   This is based on increasing paging rates and its adverse effect on response time and total system throughput.
   We are seeing the "knee of the curve" in Paging rates; they will escalate rapidly as they have before.

   MVS/XA:
   Additional memory should be in place prior to upgrading to MVS/XA, which is planned for March, 1988.

2. **CPU Upgrade:**
   Upgrade to a 3081-KX from our 3081-GX as soon as possible.
   The 3081-KX has faster CPUs than the 3081-GX, and both have 2 CPUs (processors).

   This is based on 3 factors:
   a. From time to time, the CPU is saturated with work.
      This situation sometimes occurs when jobs are running late, and competing with each other, lasting 2 or 3 hours.
      A faster CPU would process the work faster and help us to meet schedules.

   b. The 3081-KX is a better choice than a 3090 system because of an easier upgrade, Tech Support's XA schedule, and the higher cost of a 3090 upgrade.
      Upgrading to a 3081-KX would be fairly transparent to all departments, whereas installing a 3090 would involve more work at a very busy time.

   c. The 3081-KX is still a viable technology for us, for the forseeable future.
      Additionally, it has 2 processors (2 CPUs), as does our 3081-GX, which enable parallel processing to occur, and contribute to greater CPU and I/O thruput.

3. **Tape Controller:**
   Acquire an additional STC tape controller.

   Some Production schedules are not being met, and busy tape channels are part of the cause.

   Adding a 3rd tape controller, using spare channels, will reduce the traffic on the tape channels, speeding up tape jobs, and helping us to meet job schedules.
   Channels 1 and 9 are available for this purpose.

   4800:
   The STC "4800 Tape Accelerator" will be investigated as an alternative to adding a 3rd tape controller.

   3480s:
   Faster 3480 tape drives could be added later, but a conversion to 3480s is a major project. Our STC tape drives are the fastest model of their type.

4. **Tape Drives:**
   Add 2 tape drives, bringing the total to 15.
   We presently have 13 tape drives, but the Production demand for tape drives sometimes exceeds their availability.
   Adding tape drives would help us to meet job schedules.

5. **Disk Drives:**
   For increased disk capacity, replace some 3380 Standard models (single-density) with 3380-K models (triple-density).
   If necessary for performance reasons, retain some Standard models.

6. **Cached Disk:**
   For better disk thruput, investigate cached disk.

7. **SORT:**
   Increase the memory available for sorting.
   This will improve SORT times.
   Tech Support can modify the SORT Proc to specify a greater amount of memory, and modify standard SORT parameters read from SYS2.PARMLIB for internal COBOL sorts.

8. **EXCPs on JCL Listings:**
   List EXCPs (input/output counts) by DD statement on the JCL listing.
   This will enable programmers and analysts to determine where I/O bottlenecks exist for particular programs, and assist them in making improvements.
   This is also helpful in determining unexpected program begaviour.

9. **SAS:**
   Attempt to improve memory and CPU usage of the latest release.

   The latest release of SAS (5.0) takes too much memory and CPU time. It's much worse than the previous release which was also a heavy user of resources.

   For example, the old version (still in use for MICS jobs) would use 1 megabyte of memory to perform a function.
   The new version uses 3 megabytes and more CPU to perform the same function.
   Elapsed time for graphics runs is increased by 40%.
   (I still use the old version for graphics).
   According to other sources, this phenomenon has occurred before with new releases of SAS.

10. **MICS/MXG:**
    We should investigate replacing MICS with a package called MXG. MXG is cheaper, and is said to use fewer computer resources than MICS.

11. **NOMAD:**
    NOMAD is a fourth generation language for users (a 4GL).
    When it is run under TSO, it slows down or halts batch processing.
    It is not uncommon to see a NOMAD application (TSO or batch) consuming 40% or more of the CPU.

    Therefore, large NOMAD applications should be run in batch mode when possible, and in off-prime hours.

Additionally, when NOMAD is run under TSO, it is not competing with batch as an Equal after using up its high-priority time, but rather, dominates batch and competes with other TSO and CICS users.

Therefore, it would appear that IPS parameters pertaining to long-running TSO applications need to be changed at either the PERIOD level or the CLIST interpretation level.

12. Critical Paths:
The nightly and weekly jobstreams have critical paths which must complete before CICS1 is brought up in the morning. However, no one knows what these paths are.

I recommend that Operations Support determine the critical paths, publish them, and supply appropriate priorities via JCL or the Job Scheduler.
A review by Tech Support and other IRB members is advisable prior to an implementation.

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[Samples of some graphs follow]

3-YEAR FORECAST

CPU-BUSY FORECAST FOR THE 3081-GX/KX COMPUTER
USING GROWTH RATES FROM PREVIOUS YEAR

SOFTWARE ETC MIGRATED AS OF 1 JUNE 1988

Questions Answered

If we upgrade to a 3081-KX, how long will the new computer last?

Interpretation

If the computer is upgraded to a 3081-KX in March 1988, it should last until October 1989 (about 1.5 years), at present growth rates.

With our present computer, CPU capacity will be marginal through April 1988 for Prime shift.
8-hour peaks are already high.
In May 1988, safe limits will be exceeded for Prime shift.

Action

A faster computer should be installed as soon as possible.

Schedule

The upgrade to MVS/XA is planned for March, 1988.
Tech Support would need to be consulted to see if a computer upgrade and an OS upgrade can be accomplished in the same month.

Explanation

This graph shows 1 year of CPU-busy history on the left, and a 3-year forecast on the right, for each shift. Utilizations are monthly averages except for the vertical bars: Those are 8-hour peaks.

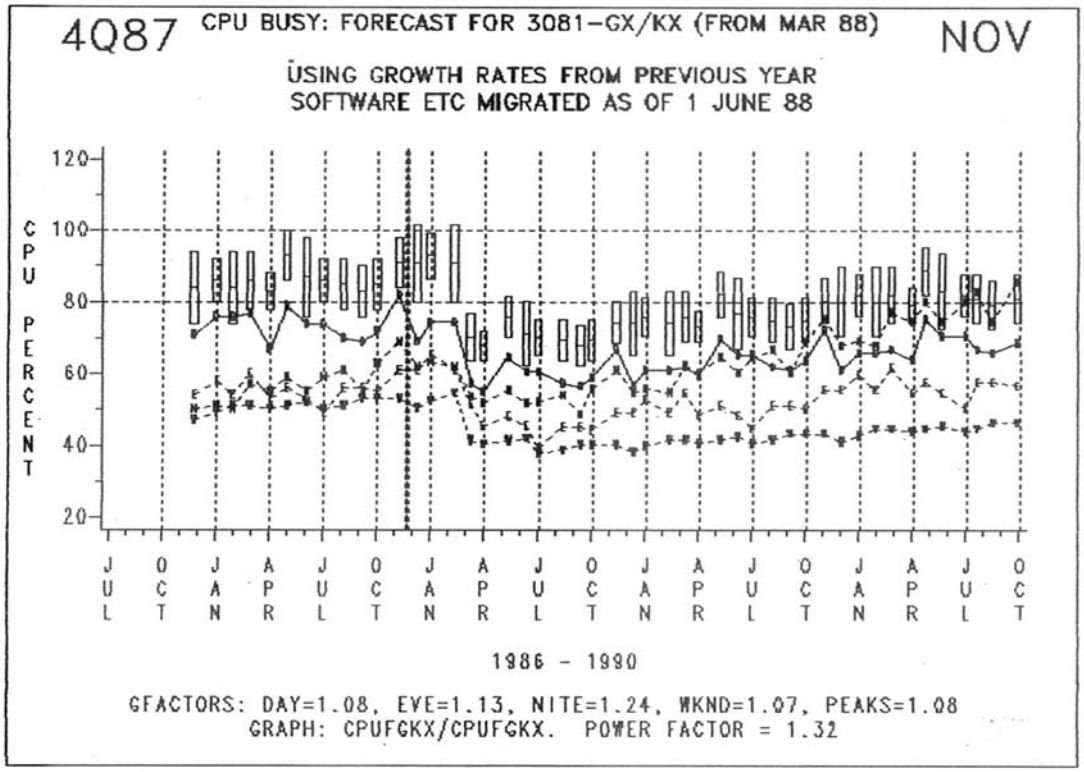
The growth rate from 1 year ago was used to pair "month with month" in order to account for seasonal variations.

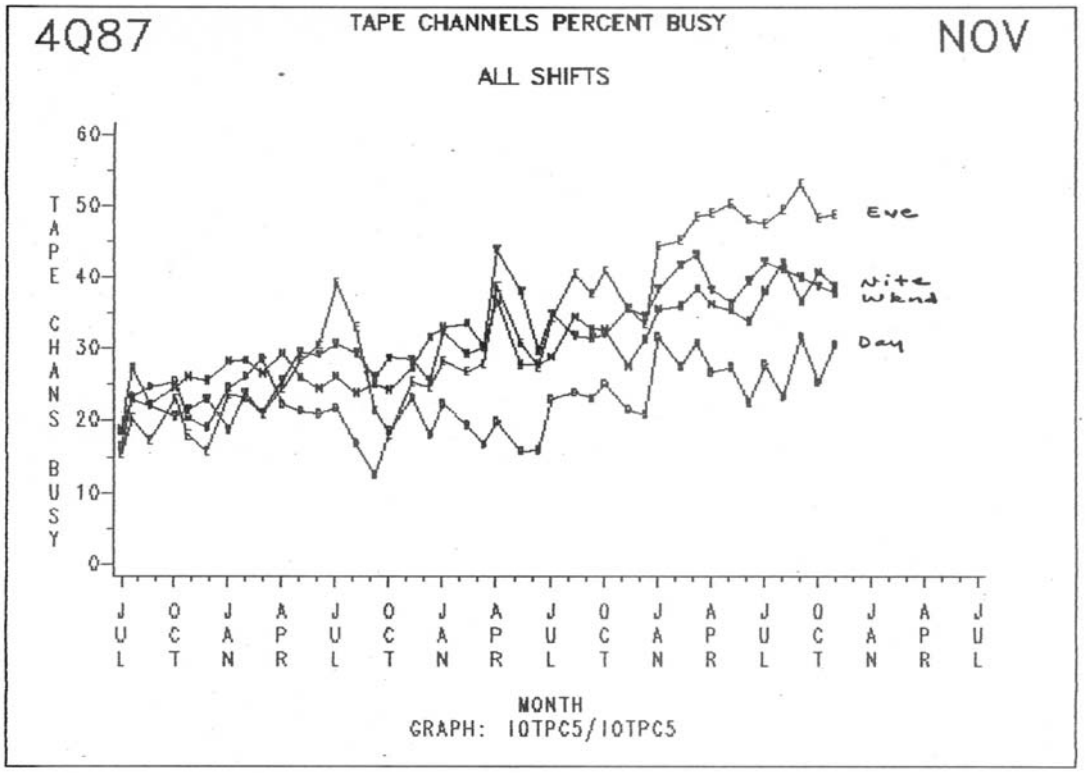
Due to the heavy CPU impact of the forthcoming Statistical Analysis processing, this forecast might be conservative.

The workload from Software Etc has been removed as of 1 June 1988, when they begin using their own computer.

Sources:

Shifts: Monthly MICS report.
Peaks: Weekly RMF report (Job JPRM01W).


4Q87
CPU BUSY: FORECAST FOR 3081-GX/KX (FROM MAR 88)
NOV
USING GROWTH RATES FROM PREVIOUS YEAR
SOFTWARE ETC MIGRATED AS OF 1 JUNE 88
CPU PERCENT
120
100
80
60
40
20
JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT
1986 - 1990
GFACTORS: DAY=1.08, EVE=1.13, NITE=1.24, WKND=1.07, PEAKS=1.08
GRAPH: CPUFGKX/CPUFGKX. POWER FACTOR = 1.32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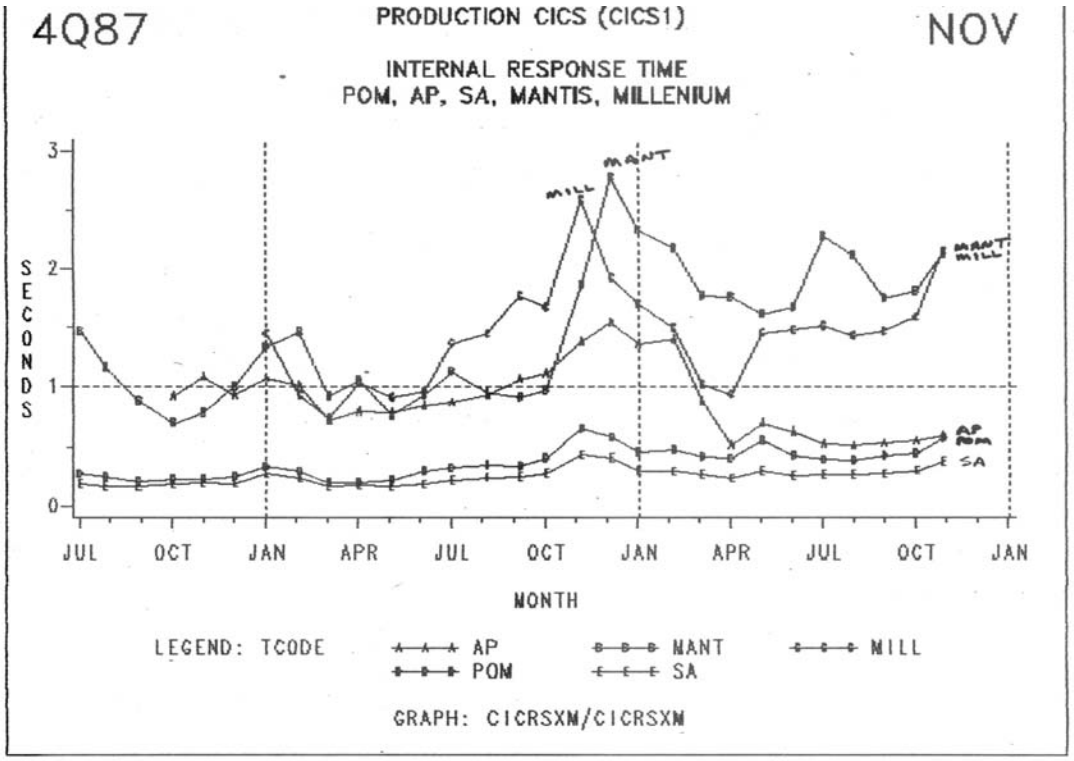
TAPE CHANNELS PERCENT BUSY
NOV
ALL SHIFTS
TAPE CHANS BUSY
60
50
40
30
20
10
0
Eve
Nite
Wknd
Day
JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL
MONTH
GRAPH: IOTPC5/IOTPC5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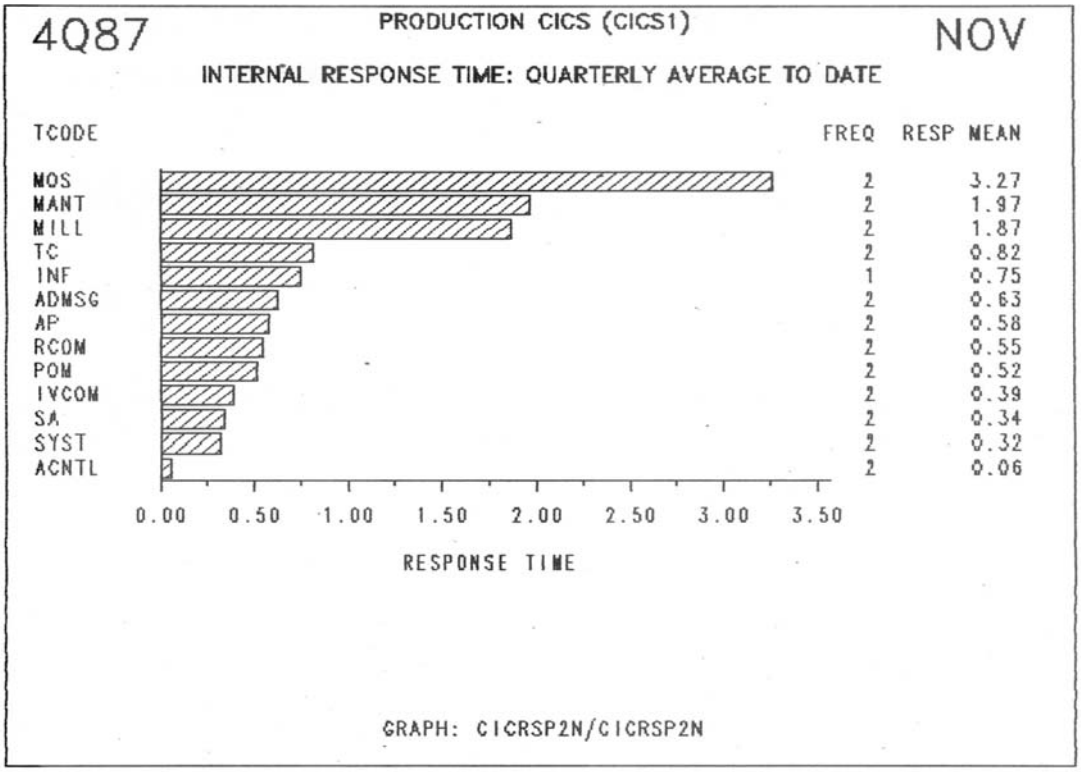
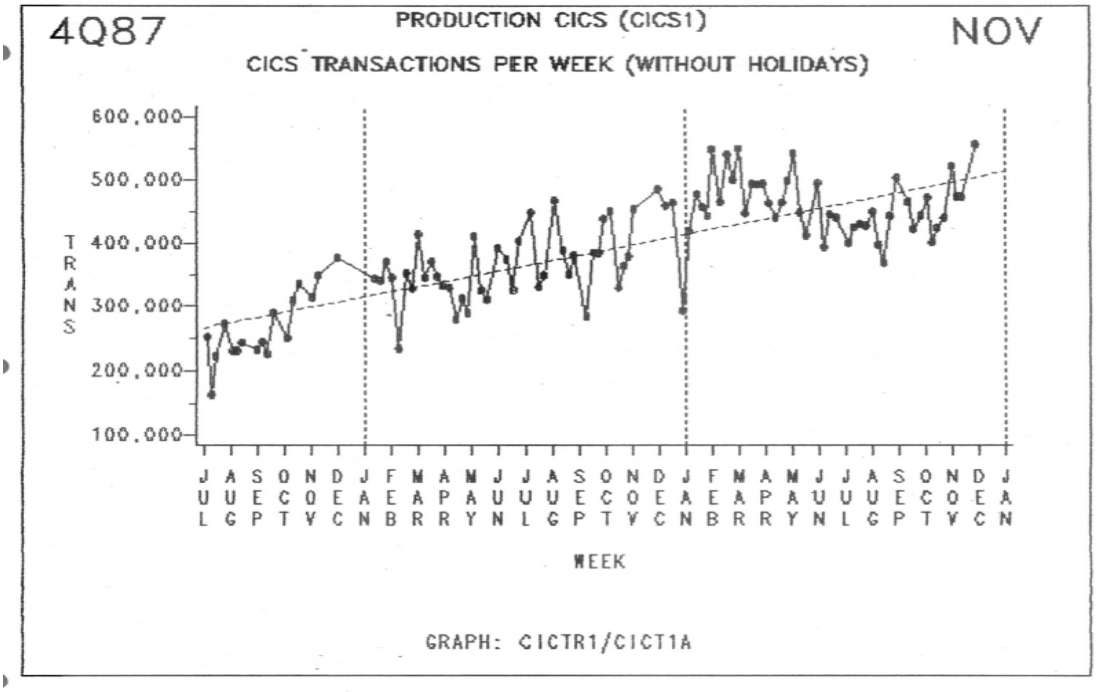
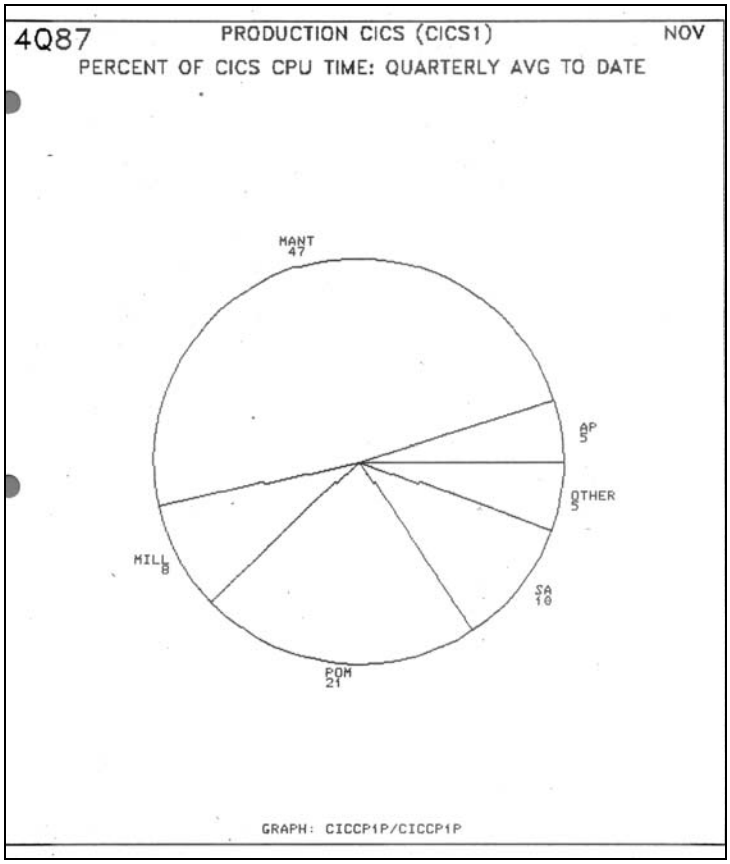
PRODUCTION CICS (CICS1)
NOV
INTERNAL RESPONSE TIME
POM, AP, SA, MANTIS, MILLENIUM
SECONDS
3
2
1
0
MANT
MILL
MANT
MILL
AP
POM
SA
JUL
OCT
JAN
APR
JUL
OCT
JAN
APR
JUL
OCT
JAN
MONTH
LEGEND: TCODE
AP
MANT
MILL
POM
SA
GRAPH: CICRSXM/CICRSXM


4Q87
PRODUCTION CICS (CICS1)
NOV
INTERNAL RESPONSE TIME: QUARTERLY AVERAGE TO DATE
TCODE
FREQ
RESP MEAN
MOS 2 3.27
MANT 2 1.97
MILL 2 1.87
TC 2 0.82
INF 1 0.75
ADMSG 2 0.63
AP 2 0.58
RCOM 2 0.55
POM 2 0.52
IVCOM 2 0.39
SA 2 0.34
SYST 2 0.32
ACNTL 2 0.06
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
RESPONSE TIME
GRAPH: CICRSP2N/CICRSP2N





[Etc. The entire report was 72 pages, and included about 30 graphs]