A Management Information System Using SAS® at the Bureau of Computer Services Data Center

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Introduction

About two years ago, Data Center managers were looking for ways of obtaining timely information on critical resource consumption. The Data Center has been going through periods of rapid growth and needed to monitor and manage the Commonwealth's hardware resources more carefully. The Data Center needed to monitor network equipment outages and service levels. After careful evaluation of products by Morrino Associates and IBM, the Data Center determined that it would be more cost/effective to write a management information system inhouse. Using current inhouse system monitors, Merrill's Expanded Guide to Computer Performance Evaluation (MXG), Job Accounting and Reporting System (JARS) from Computer Associates, and SAS, a historical resource demand data base was created. On a monthly basis, the Data Center's Management Report is automatically produced for distribution. Due to the flexibility of the SAS system, especially the Macro language, no manual intervention is required and maintenance is kept to the minimum.

This paper will give an overview of how the Management Report is produced plus a discussion on some selected charts and graphs included in the report.

Background

The Commonwealth of Massachusetts has several data centers dotted across the State. The Bureau of Computer Services (BCS), a division of the Office of Management Information Services within Administration and Finance is responsible for the State's largest data center. The Data Center is located across from the State House and operates around the clock seven days a week with about a staff of 150 employees.

The Data Center services over 160 user agencies across the State. The largest users are agencies such as the Department of Public Welfare, the Department of Social Services, the Office of the Comptroller, and the Legislature. The Data Center has installed two mainframe computers: an IBM 3090/200E rated at 32 MIPS and a Hitachi Data Systems AS/XL 100 rated at 73 MIPS. The state-wide network totals almost six thousand devices connected to two 3725 network controllers. The DASD farm has 190 gigabytes of single, double, and triple density devices installed from both IBM and HDS. In addition, the Data Center employs two 3800 laser and impact printers.

Currently the IBM system is running ESA and the HDS system is running XA. Most online systems running at the Data Center employ CICS, COMPLET, NATURAL, and ADABAS. SAS version 5.18 and 6.06 is installed in conjunction with SAS/GRAPH, SAS/FSP, SAS/ETS and MXG.

Due to the nature of the workloads, Mondays are the Data Center's heaviest processing days. Therefore, in order to avoid service impact to the user agencies, CPU capacity planning is based on Monday peak hour demand. DASD demand is based on the average day as reported from hourly DMS VTOC scans.

Management Report

The Management Report is a series of graphs, charts, and tables produced monthly from a production batch job. On a daily, weekly and monthly basis, a SAS capacity data base is updated to provide management information for the Network Services and Technical Services sections. NPM data is used to report on the network. MXG is employed to strip RMF and SMF data for reporting on CPU utilization and demand. In addition, MXG is used to capture CMF data for reporting on CICS transactions. The Commonwealth's accounting software is also used for determining how much agencies are using CPU resources.

SAS and especially the Macro Facility was employed to minimize the need for manual interven-
tion for producing the monthly report. Since each section of the Management Report was created by a Data Center staff person from their respective areas, a Macro library was developed. This was done so commonly needed functions could be shared by all sections and eliminate the need for duplication and errors. The Macro library was for such repetitive functions as eliminating weekends and holidays from the analysis, managing the SAS database, and setting up SAS system options. In addition, the Macro library was used to create look-up tables for such occurrences like changing the MIPS rating of a CPU upgrade.

Network Services

Network Services reports on device growth. The network device growth chart represents the number of terminals and printers (local and remote) defined to the Data Center's network over the previous twelve months.

Network Device Growth

The following graph depicts the 3725 CCU utilization for the Data center's two FEPs. Each plot represents the percentage of daily average of hardward cycles used for each FEP. When utilization rises above 80%, network performance will be degraded.

3725 CCU Utilization
Daily Average For May 1990

Since prime shift on Mondays is the Data Center's heaviest processing periods, the plot depicts average historical CPU demand for Mondays' peak hour. The graph also depicts the Data Center's current supply and the 85% buffer line. The Data Center gauges workload management and CPU upgrades based on when demand rises into the buffer zone. Notice that demand entered into the buffer zone around April. The Data Center is currently planning for an upgrade in the Fall of 1990.

The next plot shows how overall demand on the Data Center's CPU resources fluctuates during the course of the day. The graph plots the percentage each CPU is busy over a 24 hour period, noting the minimum, average, and maximum demand per hour. The plot represents the average Monday CPU busy for the month.
Average Monday Peak Hour CPU Demand for All Systems
With Maximum and Minimum Range
May 1990

The Data Center’s peak hour is between 11 am and noon. Overall demand is just above the 85% buffer line indicating that some additional planning is needed to avoid any service impact to the users. Also notice that the highs and lows are closer or tighter than most hours. This can be interpreted that demand is more consistent throughout the entire hour and not caused by one or a few jobs skewing the data.

The average Monday percentage of CPU busy for each system is plotted on the next graph. Included on the plot is the 85% buffer line.

Average Monday Percentage of CPU Busy by System
May 1989 Through May 1990

Notice how CPU utilization on the IBM system rose dramatically since September 1989 whereas the HDS system dipped. This was due to workload movements. In January 1990, MVS/ESA was installed on the IBM system. Consequently, CPU utilization dropped. The Commonwealth’s end of fiscal year is the end of June, causing a spike in July.

The next graph plots DASD peak hour demand in Gigabytes by month to show the Data Center’s historical DASD demand. The graph depicts the 13% buffer zone and the supply limit.

Peak DASD Storage Demand
March 1989 Through July 1990

Disk demand has been consistently growing at about a 2 gigabyte per month rate at the Data Center. Most of the growth can be attributable to production ADABAS regions. Notice the Data Center has been adding new supply so as not to overly exceed the buffer zone nor be too far below it. This is the most cost effective way of managing the purchase of new DASD. By purchasing DASD too soon and being over-supplied is a waste of money. Consequently, by being under-supplied and approaching the absolute supply limitation may impact your ability to service your customers.

The Technical Services section also reports on the following:

Average Monday CPU Demand by Agency
Average Daily CICS Demand by Region
CICS Transaction History
Average DASD Demand by Major Agency
DASD Storage by DASD Pool

Conclusion

The monthly Management Report has provided Data Center managers with key indicators as to how much resources are consumed and what Commonwealth agencies are using them. In addition, the report provides information on service levels such as end user response times. Furthermore, the report serves as a basis for the capacity management of the Data Center’s critical resources. The Management Report has been and continues to play an important role in containing expenses. The power of SAS has made this report a cost/effective realization.