



5

DEPARTMENT OF
DATA MANAGEMENT

CITY OF SACRAMENTO
CALIFORNIA

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SACRAMENTO, CA
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916-449-5763

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ALFRED S. ORTIZ
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MANAGER

TOBA L. GODDARD
COMPUTER OPERATIONS
MANAGER

DEAN W. DAVIS
TECHNICAL SYSTEMS
MANAGER

September 13, 1988

Budget & Finance Committee
Sacramento, California

Honorable Members in session:

SUBJECT: Department of Data Management Computer Upgrade

SUMMARY

Over the last six months, utilization of the City's IBM computer has increased substantially. In order to provide acceptable service levels to converted application systems as well as the new utility billing system, all of which are scheduled to reside on the IBM computer by November 1988, it is recommended that the computer be upgraded by October 1988.

This report requests that the Budget and Finance Committee recommend the City Council:

1. Suspend the formal competitive bidding procedures and;
2. Based on informal bids already received through an informal competitive bid procedure authorize the City Manager to award a contract for the procurement of used computer equipment to Encore International, Inc.
3. Adopt the attached Resolution amending the FY 1988/89 Capital Improvement Budget to provide the equipment to meet the requirements for increased Central Processing Unit capacity.

BACKGROUND

One of the more important Data Management responsibilities is to ensure that good response times and services are reliably provided, especially for the on-line critical applications. Fulfilling this responsibility requires recognition and use of performance management and/or capacity planning. Performance management activities are oriented towards assuring that existing systems meet performance goals. Capacity planning activities focus on assuring that computing capacity for future workdays will be available as needed. Together, these activities cover both the current and future planning requirements within the basic Data Management response time and service responsibility.

To contrast the current Sperry system capabilities with what can be done on the current IBM computer the Sperry is weak in providing the software tools to analyze how the system performs under the workload it is expected to process. This performance may, for instance, be viewed in terms of amount of traffic between data storage devices and Central Processing Unit, percentage of Central Processing Unit being used, number of on-line transactions, etc. On the contrary, the capabilities for that type of analysis within the IBM software environment are abundant. Data collection is basic to the IBM software and the administration, analysis and reporting can become as sophisticated and extensive as an installation wishes. The only limit is expense of the software, availability of historical data and overhead issues such as disk storage and computer capacity to run large forecasts or analyses. Although the IBM offers increased capabilities, tools, tighter control on security, data storage devices and tape access there is increased overhead required for this. If capacity planning software had been available on the Sperry, a snapshot of number of programs run each day, file accesses and Central Processing Unit time used would have enabled staff to utilize the resultant information for a more accurate selection of a computer and projected upgrades. In reviewing the notes from the computer planning sessions which took place in 1986, more "rules of thumb" were used than actual statistics since good planning data from the Sperry was not readily available. In addition, the IBM differences in software and file handling are factors which increase the complexity of accurately projecting computer requirements.

ANALYSIS

The Data Management Department, through trial usage of software, and the purchase of a statistical analysis system has embarked upon formalizing the performance measurement and evaluation process. A result of this effort is depicted in the following narrative and graphs concerning the City's current IBM computer.

As current systems are enhanced and improved and more programs and systems are added in response to the City's pent-up computing demand, projections indicate that the current Data Management computer (IBM 4381) will reach a level of usage which will cause terminal lockouts and system outages as well as increased response times (potentially as much as 3-5 minutes) for terminal users trying to access City information. This slowdown of the computer is projected to occur by mid-October 1988 as more systems are converted to the IBM 4381. (See Attachment 'C' - Projected Growth).

During the month of June, the 4381 peaked at approximately 60-65% usage at least once a week and during July for smaller periods of time during the day has peaked at 90-100%, (See Attachment 'D' and 'E' - Average Utilization by Day of Week). That usage does not include Utility Billing, Payroll, Pension Payroll, Bonds and Parcel processing; all of which are yet to be installed on the 4381.

A review of the selection of the 4381 indicates that there was limited detailed analysis of capacity issues or anticipated new application system demands. As discussed above, due to the limited Sperry information and to the lack of IBM knowledge, incremental computer utilization caused by a 4th generation tool (FOCUS), increased development and usage of IBM TSO (Time Sharing Option) software for conversion work, COBOL-XE overhead (10% increase for each program) and the operating system (MVS/XA). The planning was too conservative if tied to a seven year utilization of the 4381. Because this computer's role is to accommodate an on-line, interactive environment, response time becomes critical as well as job turnaround. To achieve acceptable (.2-.5 minute) response time, the computer should not exceed a 75% utilization range; thus, in capacity planning, daily usage peaks should be scrutinized as well as planned or anticipated work-out growth.

It is essential that Data Management remove the Sperry computer at the end of 1988 which means all remaining Sperry applications must be converted to the IBM 4381. Since the forecast of utilization indicates a "maxing out" of the 4381, it is recommended that an upgrade of capacity occur prior to 1988 year-end. "Maxing out" connotes a response time of two to four minutes, processing ability for only 75% of batch jobs and less availability and reliability of the on-line systems. The current operations staff has begun working on Saturdays via overtime to process remaining jobs which could not be completed on Friday night and early Saturday. This condition will greatly

deteriorate as more programs are moved from the Sperry to the IBM computer. The following is a list of existing application systems the IBM computer is to process:

Conversion
Completed

- x Utility Billing (currently being replaced)
- x Business License
- x Animal License
- Payroll
- x Geocode
- x Traffic Accidents

- Parcel/Transfer Tax
- Fixed Assets
- x Financial System (LGFS)
- x Telephone Billing
- x Energy Management
- x Senior Citizens
- x City Clerk
- x Workers Compensation
- x Weed and Nuisance Abatement
- Expense and Revenue
- x Stockless Office Supplies
- Police Alarms
- Fire Permits

12

Due to time constraints, the above systems are being converted "as is" without any individually applied enhancements.

Longer Term Strategy

Over a longer term, all of the IBM application systems need to be reprioritized in order of City impact. Some systems may benefit from minor enhancements which will:

- Add more audit controls and checks
- Allow for ease of changes
- Remove the manual intervention requirements such as date cards and control sheets
- Provide more on-line user friendly accessibility and easier report generation.
- Reduce continual programmer involvement in day-to-day production operations
- Include on-line data entry

Some systems such as payroll will need such a major overhaul that a rewrite or purchase of a new system will be required.

All of the above issues and strategies require increased processing capabilities. Contrasted to the 10 year life of the Sperry, these automation and productivity opportunities drive the need for larger computers at more frequent intervals.

Decision support software should also be considered so that City officials and management who do not wish to become programmers or typists can still access data which will assist in decision making and planning. Tools should also be installed which remove the "art" of programming and create a science of program engineering. In the long run, this will achieve consistent program code generation with 80%+ accuracy and curtail the growth of programming staff.

None of the above drive a need for the newest hardware technology but will require additional capacity.

Issues

The 4381 was purchased from the 1986 Certificate of Participation (COP) fund. This diminishes the number of options available since a computer or some asset of like value must exist as security.

The 4381 is decreasing in value rapidly and its replacement is to be announced by IBM in the fall 1988, at which time its value should further plummet.

ALTERNATIVES

IBM rates its computers through million instructions per second (MIPS). There are other IBM computers which are somewhat older in age and technology but offer more than double the capacity of the 4381 at less cost per MIP. (See Attachment 'F' - Growth VS MIPS Cost). But since technology is only an enabler, permitting new strategies to be executed, those facing the City and Data Management can be satisfied without being at the vanguard. A review of cost per MIPS for possible upgrade alternatives follows:

| | | <u>\$/MIP</u> | <u>#/MIPS</u> | <u>Monthly Maintenance</u> |
|-----------|----------|---------------|---------------|----------------------------|
| (current) | 4381-14 | 45,000 | 6.0 | \$790 |
| | 4381-24 | 128,000 | 7.8 | 858 |
| | 3090-150 | 124,000 | 9.2 | 2,400 |
| | 3090-180 | 121,000 | 15.4 | 2,870 |
| | 3081KX | 22,000 | 15.5 | 4,670 |
| | 3084 | 25,400 | 28.7 | 9,880 |
| | 3090-200 | 98,600 | 31.9 | 5,900 |

All of the above listed IBM computers offer comparable reliability and all support the City's existing software base. The 3090 computers require chilled water, whereas the others listed can be air cooled. The upgrade from the current IBM 4381 to any of the above computers would not require any software conversion or change. All existing IBM tape and data storage device drives are compatible with the above computers.

FINANCIAL ANALYSIS

With a projected compounded growth rate of 25%, a less expensive 3081KX will serve the City's needs for the next three years until such time that a replacement can be purchased to coincide with the Data Management move into other facilities so that the parking garage at 10th and I can be demolished. The upgrade cost for a 4381 to a 3081KX is approximately \$166,738. Additional annual charges totaling \$76,078 would be incurred for hardware maintenance, software maintenance and software purchases priced according to computer size. The first year cost for the Central Processing Unit upgrade is \$242,816. (See Attachment 'G' - 3 Year Central Processing Unit Upgrade).

Funding in the amount of \$100,000 is available in Data Managements 1988/1989 operating budget, Fund 101-130-1330-4630. An additional amount of \$142,816 available through the 1986 Certificate of Participation Contingency Fund (702).

Although the 3081KX computer is not on the leading edge of technology, it provides growth capabilities for applications which have been converted from the Sperry, through enhancements or replacement, and allows for the City to seize upon new opportunities for automation. The 3081KX is not the ultimate solution but one which is affordable in the short run. Based on the above and additional statistical analysis, it is recommended that a 3081KX upgrade be purchased for City main-frame applications.

RECOMMENDATION

It is requested that the Budget and Finance Committee recommend that the City Council:

1. Suspend the formal competitive bidding procedures and;
2. Based on informal bids already received through an informal competitive bid procedure authorize the City Manager to award a contract for the procurement of used computer equipment to Encore International, Inc.

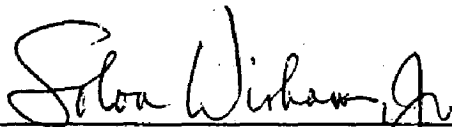
3. Adopt the attached Resolution amending the FY 1988/89 Capital Improvement Budget to provide the equipment to meet the requirements for increased Central Processing Unit capacity.

Respectfully submitted,



Barbara C. Weaver
Data Management Director

RECOMMENDATION APPROVED:



FC JACK CRIST
DEPUTY CITY MANAGER

RESOLUTION NO.

ADOPTED BY THE SACRAMENTO CITY COUNCIL ON DATE OF

RESOLUTION TRANSFERRING AND APPROPRIATING
FUNDS IN THE AMOUNT OF \$242,816 FOR
UPGRADING THE CENTRAL PROCESSING UNIT

BE IT RESOLVED BY THE COUNCIL OF THE CITY OF SACRAMENTO:

1. The 1988-89 Capital Improvement Budget is amended by establishing the 3081KX Central Processing Unit Upgrade project and transferring \$100,000 from Data Management's 1988-89 Operating Budget to the project and appropriating \$142,816 from the 1986 Certificate of Participation Contingency Fund (702) as follows:

From:

| | |
|-------------------|-------------|
| 101-130-1330-4630 | <\$100,000> |
| 101-130-1310-4376 | \$100,000 |

To:

| | |
|-------------------|-----------|
| 702-500-XXXX-3717 | \$100,000 |
|-------------------|-----------|

Project Budget:

| | |
|-------------------------|------------------|
| From Data Management | \$100,000 |
| From 86 COP Contingency | <u>\$142,816</u> |

| | |
|-------------------|----------------------|
| 702-500-XXXX-4630 | \$166,738 (Hardware) |
| 702-500-XXXX-4241 | 35,904 (Maintenance) |
| 702-500-XXXX-4462 | 40,174 (Upgrade) |

MAYOR

ATTEST:

CITY CLERK

SUGGESTED VENDOR LIST

Alternative Data Communication Sources
2932 Red Hawk Way
Sacramento, CA 95833

Atlantic Computer Systems, Inc.
655 Montgomery Street
San Francisco, CA 94111

Beaverlake Corporation
8055 W. Manchester Ave., Suite 535
Playa Del Rey, CA 90293

Cameo Computer Corporation
22850 Crenshaw Blvd., Suite 205
Torrance, CA 90505

CIS Corporation
909 Montgomery Street, 3rd Floor
San Francisco, CA 94133

Comdisc
6400 Shafer Court
Rosemont, IL 60018

Computer Maintenance Corporation
5061 Oakbrook Parkway
Norcross, Georgia 30093-1798

Computer Marketing of America, Inc.
P.O. Box 71
510 Bryan Street
Old Hickory, Tennessee 37138

Computer Resources Technology
5716 Riverside Blvd.
Sacramento, CA 95822

El Camino Resources
36 Woodoaks Drive
San Rafael, CA 94903

EMC Corporation
400 Oyster Point Boulevard, Suite 117
South San Francisco, CA 94080

Encore International Inc.
11 East Long Lake, Suite 110
Bloomfield Hills, MI 48013

Hartford Computer Group, Inc.
1610 Colonial Parkway
Inverness, Ill. 60057

SUGGESTED VENDOR LIST

IBM

520 Capitol Mall
Sacramento, CA 95814

Information Processing Systems, Inc.
Continental Plaza III
433 Hackensack Ave.
Hackensack, N.J. 07601

Leascom

108 Main Street
Tiburon, CA 94920

Neptune, Marshall, Lewis
1536 Brockhollow Drive, Bldg. A
Santa Ana, CA 92705-5426

Newport Leasing, Inc.
2 Faraday
Irvine, CA 92718

OAC Services, Inc.
10392 Rockingham Drive
Sacramento, CA 95827

PacificCorp Capital Inc.
531 J Street, Suite 600
Sacramento, CA 95814

Phoenix Leasing
4201 Kerner Blvd.
San Rafael, CA 94901

STI (Storage Technology Corporation)
1900 Point West Way
Sacramento, CA

The Meridian Group
570 Lake Cook Road, Suite 300
Deerfield, IL 60015

Western Computer Group, Inc.
952 Burlway Road
Burlingame, CA 94010-1705

Xerxes Computer Sales
10759 Bren Road East
Minnetonka, Minnesota 55343

CPU UPGRADE SPECIFICATIONS

CURRENT ENVIRONMENT

Introduction

The City of Sacramento Data Management Department is responsible for providing data processing services to all departments within the City government. The City has a considerable investment in existing equipment, software, facilities, and staff training. Because of this investment, products and services offered by the vendor in response to this RFP must be compatible with all equipment and software currently installed at the City, and with all equipment and software the City is planning to install.

There is currently a IBM 4381 model group 14 installed.

Installed Equipment

A list of all equipment currently installed at the City is shown in the Appendix of this RFP. All equipment proposed in response to this RFP must support the currently installed equipment listed in Appendix A.

Installed Software

A list of all software currently installed at the City is shown in the Appendix of this RFP. All equipment proposed in response to this RFP must support the currently installed software listed in the Appendix B.

Equipment Planned for Future Installation

The City is planning to install the equipment listed below during the next 24 months. All equipment proposed in response to this RFP must support the following equipment:

- o 1 Xerox 4050 Laser Printing System (or equivalent)
- o 1 Xerox 4060 Laser Printing System (or equivalent)
- o 2 IBM 3880-003 Direct Access Storage Controllers
- o 3 IBM 3380-AD4 Direct Access Storage Devices
- o 5 IBM 3380-8D4 Direct Access Storage Devices
- o 5 IBM 3174-1L Local Cluster Controllers

Software Planned for Future Installation

The City is planning to install the software listed below during the next 24 months. The equipment proposed in response to this RFP must support the following software.

- o SAS
- o Source Code Manager
- o Super Natural - Natural Connection
- o Sysout Archival and Retrieval
- o On-Line Report Management Software
- o Problem Management Software
- o MVS/XA Release 2.2

PROPOSED SYSTEM

Pricing Schedule

| <u>No.</u> | <u>Quantity</u> | <u>Description</u> | <u>Cost</u> |
|------------|-----------------|------------------------------------------------|-------------|
| 1 | 1 EA | IBM 3081-KX3 Central Processor | \$ _____ |
| | | Installation | \$ _____ |
| 1 | 1 EA | IBM 3082-X24 Processor Controller | \$ _____ |
| | | Installation | \$ _____ |
| 1 | 1 EA | IBM 3087-002 Coolant Distribution Unit | \$ _____ |
| | | Installation | \$ _____ |
| 1 | 1 EA | IBM 3089-001 Power Unit | \$ _____ |
| | | Installation | \$ _____ |
| | | Shipping | \$ _____ |
| | | De-installation of IBM 4381-Q14 | \$ _____ |
| | | Ship-out of IBM 4381-Q14 | \$ _____ |
| | | Applicable Sales Tax | \$ _____ |
| | | Subtotal | \$ _____ |
| | | Less Trade-in Value of Current IBM 4381-Q14 | \$ _____ |
| | | TOTAL COST TO CITY | \$ _____ |

Proposed Equipment

The City is soliciting the following equipment, or equipment that is functionally equivalent to the following:

- 14 MIPS minimum internal processing capacity
- 32 Megabytes of Main Storage
- 16 3-Megabyte/Second Channels
- Air Cooled Processor
- Power Distribution Unit Including Motor Generator

The proposed equipment will replace the currently installed IBM 4381 system.

Used Equipment

The City will accept used equipment. If used equipment is proposed, the City requires that:

1. The equipment must be certified to be at the current manufacturer's engineering change level.
2. The equipment must be certified as being maintainable by the manufacturer.
3. The equipment has met the "Productive Use History" and "Reliability Data" requirements of this RFP during the last 3 months of operation at its most recent installation.
4. The equipment must be physically cleaned and refurbished so as to appear cosmetically similar to new equipment.

If the vendor proposes used equipment, the vendor's Bid must clearly identify all items that are used equipment.

Equipment to be Replaced

The vendor must accept the current equipment as a payment towards the replacement processor:

IBM 4381 Model Group 14 serial number 14415

12 channels standard

32 megabytes of EMC2 Model E4381-2 main storage

- o Chip size: 256K Ram Mos
- o Mean Time Between Failure (MTBF): 40,000 hours
- o Access Time: 120 nanoseconds
- o Word size: 39 bits
- o Power: 15 watts
- o Dimensions: 6.7 x 8.6 inches (at widest point)

TECHNICAL REQUIREMENTS

Mandatory Requirements

Failure to respond to any requirements in this section, or non-adherence to any requirement in this section, may cause the Bid to be rejected.

1. The proposed equipment must provide a minimum internal speed of 14 MIPS.
2. The proposed equipment must provide 16 I/O channels, each capable of supporting a minimum data exchange rate of 3 megabytes per second.
3. The proposed equipment must be able to support an aggregate channel data rate of 48 megabytes per second.
4. All I/O channels on the proposed equipment must be able to operate using the Data Streaming channel Protocol.
5. The proposed equipment must operate in conformance with System/370 Extended Architecture as documented in the IBM Principals of Operation manual GA22-7000-10.
6. The proposed equipment must contain support for the following:
 - The "Start Interpretive Execution" instruction.
 - The "Dual-Address-Space Facility".
 - The "Storage-Key 4K-Byte-Block Facility".
 - The "Low-Address-Protection Facility".
 - The "Segment-Protection Facility".
 - The "Storage-Key-instruction-Extension Facility".
 - The "Test-Block Facility".
 - The "Extended-Real-Addressing Facility".
7. The proposed equipment must support extended real addressing (26-bit) in S/370 mode.
8. The proposed equipment must support bimodal addressing (i.e., both 24 and 31 bit) in 370-XA mode.
9. The proposed equipment must support 31-bit real addressing in 370-XA mode.
10. The proposed equipment must support Dynamic Path Selection.

and Dynamic Channel Reconnect for an MVS/XA environment, and must be capable of selecting from as many as four paths to any I/O device.

11. The proposed equipment shall not affect the operation or require the conversion of any of the City's MVS/XA, JES2 application programs, sub-routines, user written software programs, teleprocessing programs, or contracted program products (see "Current Environment" section).
12. The proposed equipment must be fully compatible with the City's 4381-14 system such that the MVS/XA workloads can be swapped to alternate processors.

OTHER REQUIREMENTS

Productive Use History

Each component proposed by the vendor in response to this RFB should be installed at least six (6) months prior to July 1, 1988.

Substantial design changes in components should not occur; however increases or decreases in the number of such components, including any required interconnect alterations may be allowed, if no substantial changes in logic, architecture or design are involved.

Reliability Data

Data must be submitted in writing which indicates the reliability of the vendor's proposed equipment. These data must include, but are not limited to, historical availability figures for the equipment proposed by the vendor. Availability for any piece of equipment must be based on at least 600 hours of use within a six (6) month period. Availability is calculated as follows:

$$\text{Percent Availability} = \text{AT} / (\text{AT} + \text{DT})$$

where,

AT is Available Operational Use Time.

DT is Down Time, which is defined as the accumulated periods beginning when the vendor is notified of equipment failure and ending when the equipment is returned to the customer in operating condition.

Scheduled preventive maintenance is not considered to be included in either AT or DT.

Copies of Reliability Research Inc. R+ reports must be supplied by the vendor to document the bid equipment's reliability over the past year.

APPENDIX A
CURRENTLY INSTALLED IBM EQUIPMENT

| <u>QTY</u> | <u>DESCRIPTION</u> | <u>TYPE/MODEL</u> |
|------------|----------------------------------|-------------------|
| 1 | Central Processing Unit | 4381-Q14 |
| 2 | Direct Access Storage Devices | 3380-AD4 |
| 4 | Direct Access Storage Devices | 3380-BD4 |
| 1 | Direct Access Storage Controller | 3880-003 |
| 5 | Magnetic Tape Drives | 3420-008 |
| 1 | Tape Controller | 3803-003 |
| 1 | Communications Controller | 3725-002 |
| 1 | Local Cluster Controller | 3274-41C |
| 1 | Line Printer | 4245-020 |

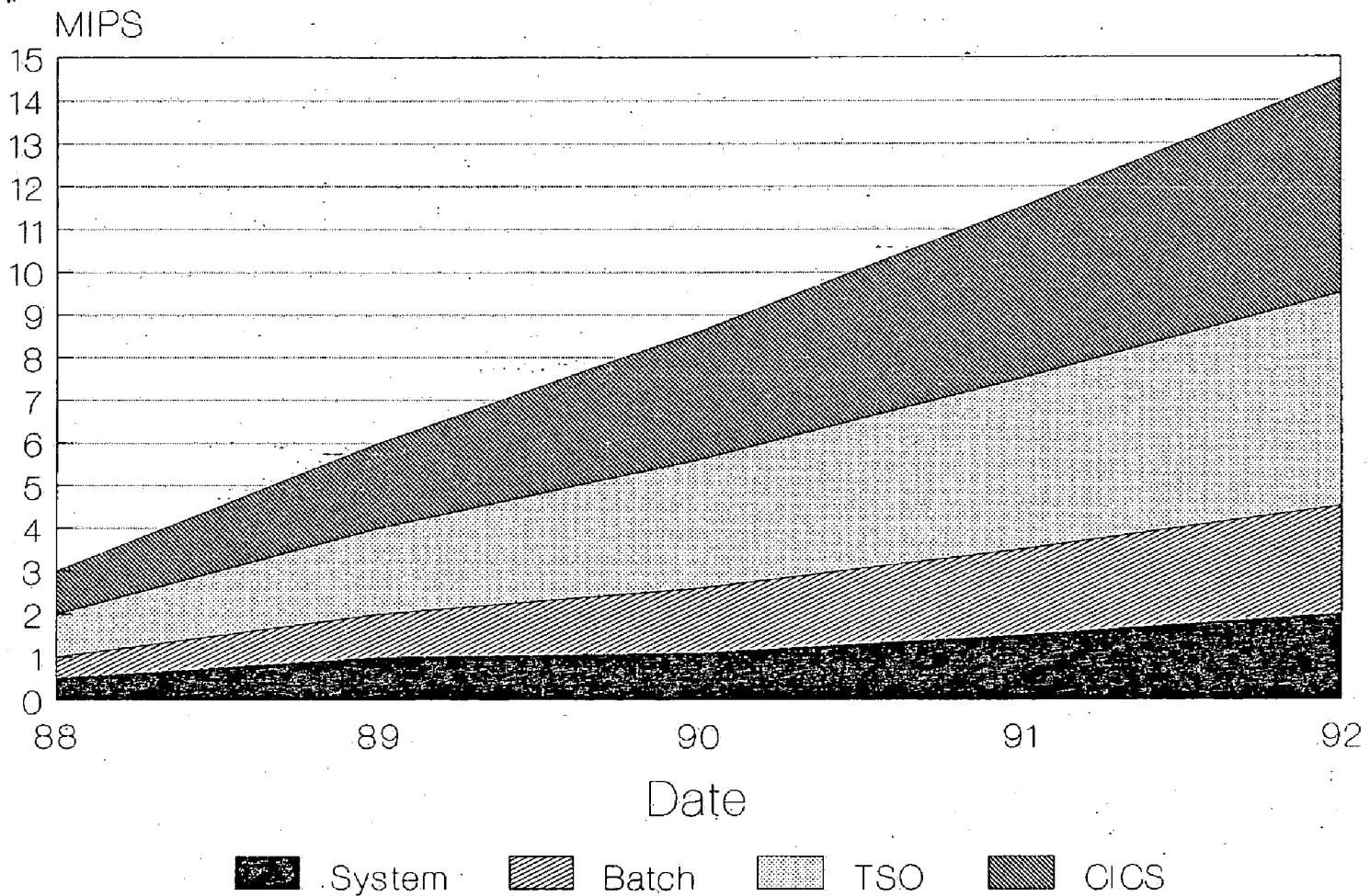
APPENDIX B
CURRENTLY INSTALLED SOFTWARE

| <u>PRODUCT CODE</u> | <u>DESCRIPTION</u> |
|---------------------|-------------------------------------|
| IBM 5665-XA2 | MVS/XA DFP |
| IBM 5665-274 | RMF Version 3 |
| IBM 5665-285 | TSO Ext for MVS/370 |
| IBM 5665-289 | ACF/VTAM for MVS/370 |
| IBM 5665-317 | ISPF/PDF for MVS |
| IBM 5665-319 | ISPF Dialog Manager |
| IBM 5665-327 | DFDSS |
| IBM 5665-338 | ACF/SSP Version 3 for MVS |
| IBM 5667-124 | ACF/NCP Version 3 |
| IBM 5668-949 | SMP/E for OS/VS2 (MVS) & OS/VS |
| IBM 5668-962 | Assembler H V2R1 |
| IBM 5734-LM5 | Transient Lib (OS) |
| IBM 5740-CB1 | OS/VS Cobol Compiler |
| IBM 5740-SM1 | OS/VS Sort/Merge |
| IBM 5740-XC6 | MVS/SP Version2-JES2 |
| IBM 5740-XX1 | CICS OS/VS |
| ADA | ADABAS |
| CA1 | Tape Management System |
| CA7 | Automated Production Control System |
| CA11 | Automated Rerun and Tracking System |
| COB | COBOL |
| COB | COBOL/XE |
| CSA | COBOL Source Arranger |
| DMS | Disk Management System |
| DFH | CICS Installation |

APPENDIX B (Continued)
CURRENTLY INSTALLED SOFTWARE

| <u>PRODUCT CODE</u> | <u>DESCRIPTION</u> |
|---------------------|--------------------------------------|
| DSF | Device Support Facilities |
| EMAIL | Electronic Mail |
| FOC | FOCUS |
| GDF | Generalized Dataset Allocator |
| ICE | DF/Sort |
| ICF | Forward Catalog Recovery |
| ISF | Spool Display and Search Facility |
| JES | JES2 |
| NCP | Network Control Program |
| NAT | Natural |
| OMN | Omegamon |
| OMC | Omegamon/CICS |
| NMP | Netmaster |
| PDS | TSO PDS Command Processor |
| SMP | System Modification Program/Extended |
| STX | STOP X-37 |
| TSS | Time Sharing Subsystem Option |
| TSS | Top Secret |
| VAM | VSAM Allocation Manager |

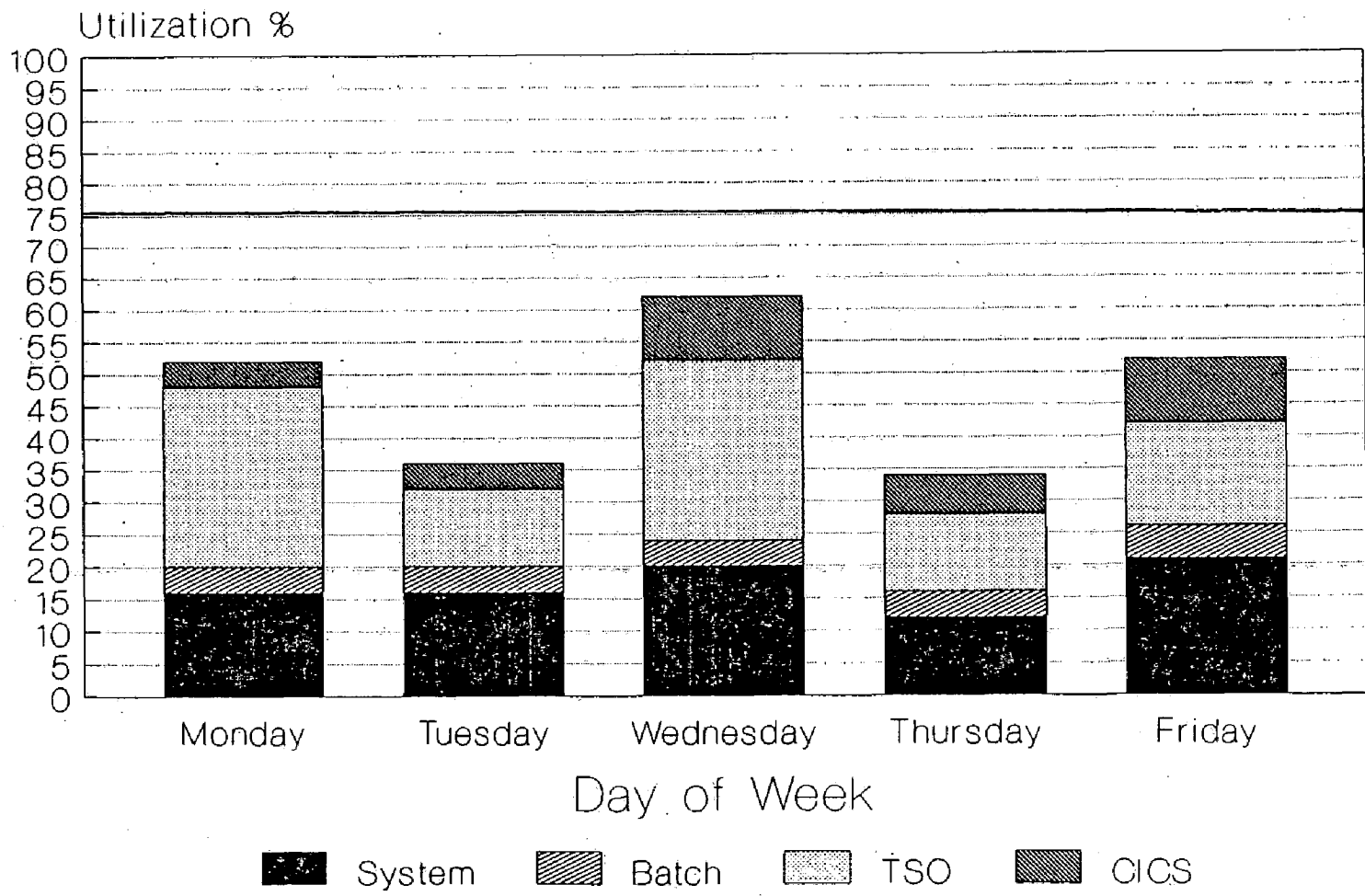
City of Sacramento Projected Growth



MIPS=Million Instructions Per Second

City of Sacramento

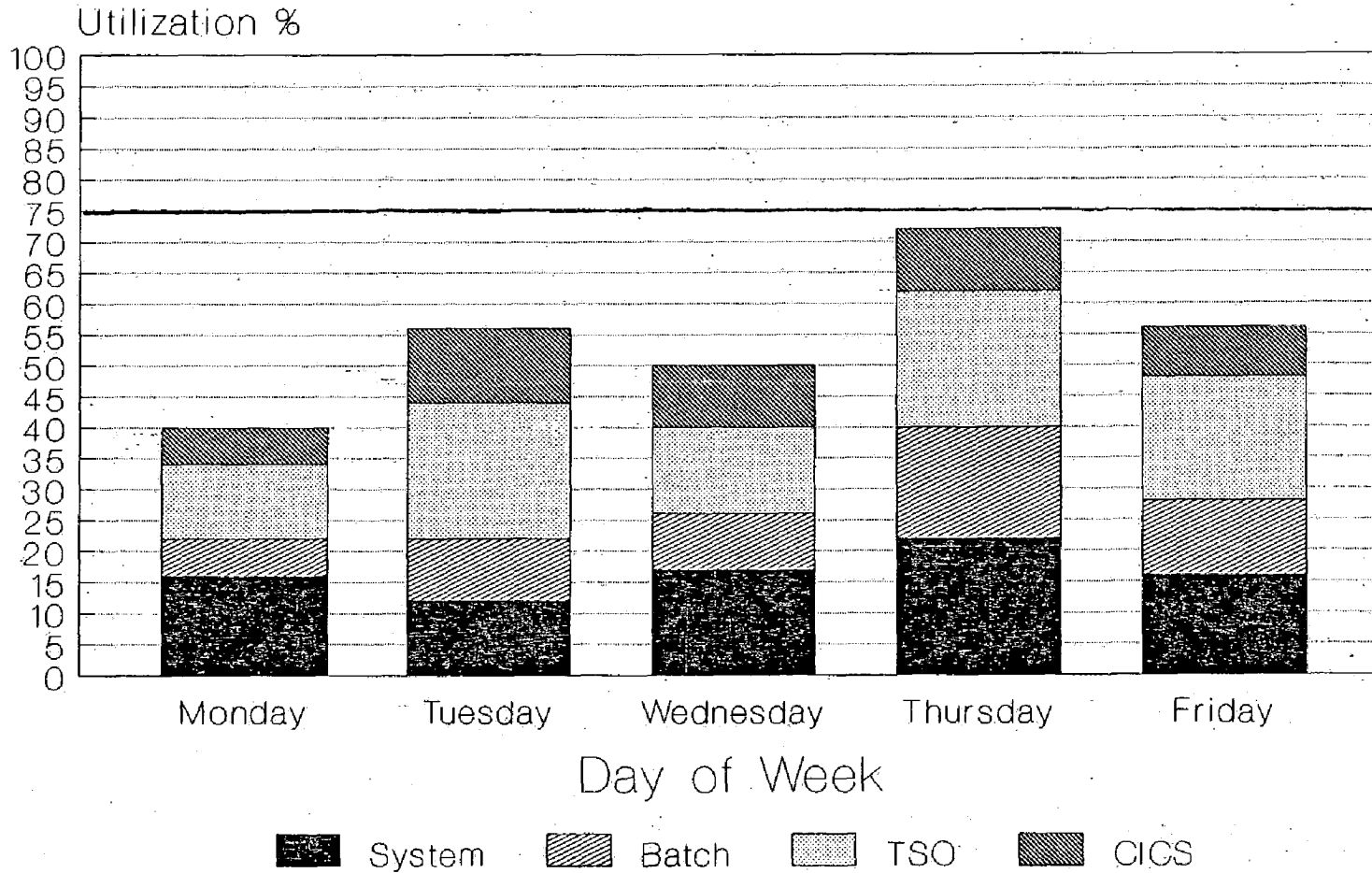
Average Utilization by Day of Week



Month of July

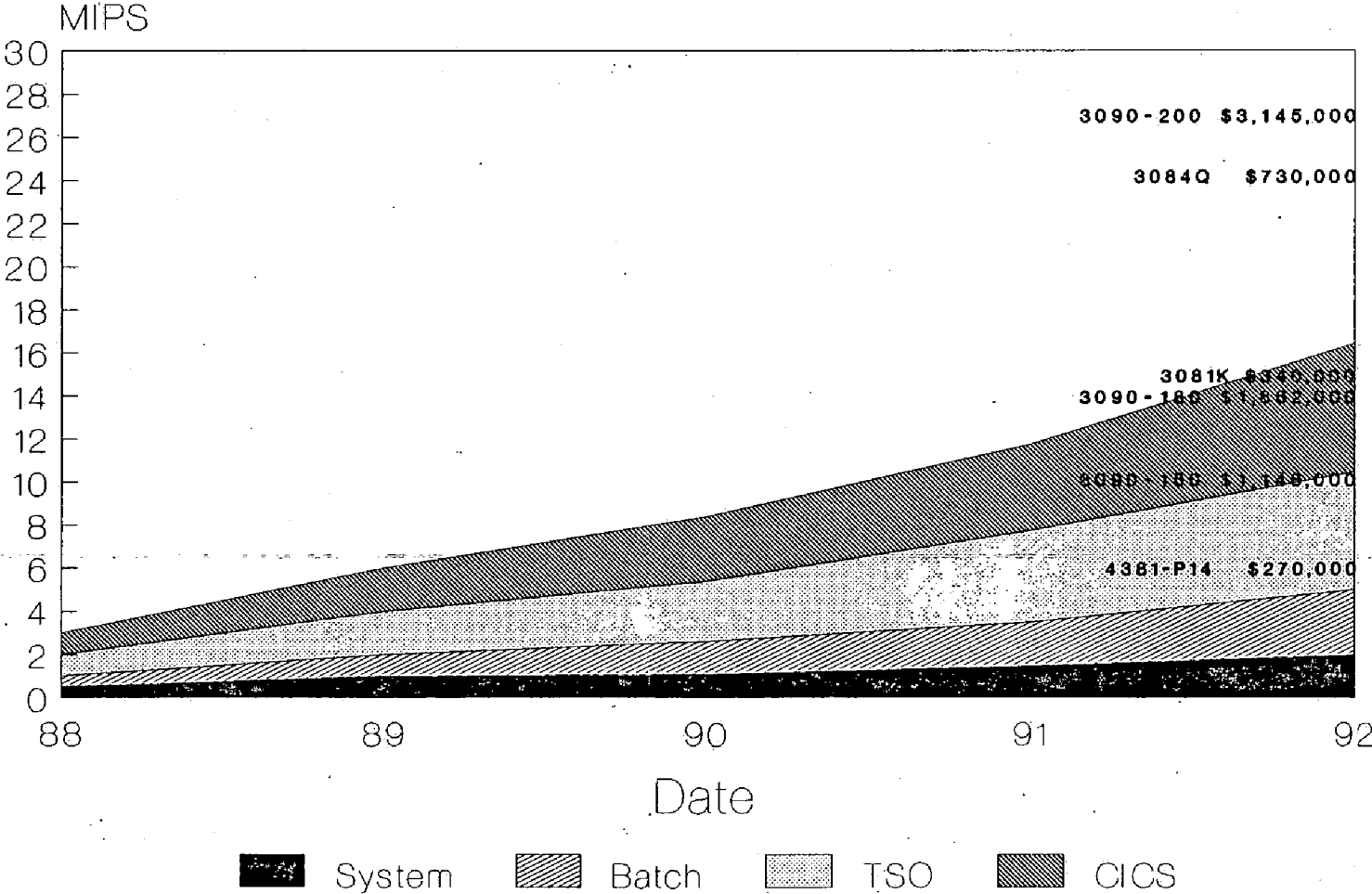
City of Sacramento

Average Utilization by Day of Week



Period Covered July 21 - August 22

City of Sacramento Growth vs. MIPS Cost



MIPS=Million Instructions Per Second

**3 Year CPU Upgrade
Incremental Cost Analysis
(15 MIP Requirement)**

09/13/1988

13:37:04

| <u>CURRENT CPU:</u> | | | | |
|---------------------|------------------|------------------|------------------|--------------------|
| | 1988-89 | 1989-90 | 1990-91 | TOTAL |
| <u>4381</u> | | | | |
| Maintenance | 9,480 | 10,049 | 11,054 | |
| Software | 417,896 | 438,790 | 460,730 | |
| | <u>\$427,376</u> | <u>\$448,839</u> | <u>\$471,784</u> | <u>\$1,347,999</u> |

| <u>PROPOSED CPU'S (15 MIPS)</u> | | | | |
|---------------------------------|--------------------|-----------------|-----------------|--------------------|
| | 1988-89 | 1989-90 | 1990-91 | TOTAL |
| <u>3081K</u> | | | | |
| Upgrade | 157,300 | -0- | -0- | |
| Maintenance | 31,040 | 51,495 | 57,987 | |
| | <u>\$188,340</u> | <u>\$51,495</u> | <u>\$57,987</u> | <u>\$ 297,822</u> |
| ----- | | | | |
| <u>3090-180</u> | | | | |
| Upgrade | 1,622,000 | -0- | -0- | |
| Maintenance | 18,720 | 26,013 | 28,614 | |
| | <u>\$1,640,720</u> | <u>\$26,013</u> | <u>\$28,614</u> | <u>\$1,695,347</u> |

| <u>SOFTWARE BOTH CPU'S</u> | | | | |
|----------------------------|------------------|-----------------|-----------------|------------------|
| | 1988-89 | 1989-90 | 1990-91 | TOTAL |
| Upgrade (1) | 37,900 | -0- | -0- | |
| Maintenance (15%) | 2,832 | 5,183 | 5,961 | |
| | <u>\$ 40,732</u> | <u>\$ 5,183</u> | <u>\$ 5,961</u> | <u>\$ 51,876</u> |

| <u>RECOMMENDED CPU</u> | | | | |
|-------------------------------------|------------------|-----------------|-----------------|-------------------|
| | 1988-89 | 1989-90 | 1990-91 | TOTAL |
| <u>3081K</u> | | | | |
| CPU UPGRADE AND MAINTENANCE | 188,340 | 51,495 | 57,987 | |
| SOFTWARE UPGRADE AND MAINTENANCE | 40,732 | 5,183 | 5,961 | |
| | <u>\$229,072</u> | <u>\$56,678</u> | <u>\$63,948</u> | <u>\$ 349,698</u> |
| TAX | 13,744 | 3,400 | 3,836 | 20,980 |
| | <u>\$242,816</u> | <u>\$60,078</u> | <u>\$67,784</u> | <u>\$ 370,678</u> |

(1) Software Upgrade Costs

- SUPPER NATURAL . NETMASTER . TOP SECRET
- NATURAL/CONNECTION . STOP-X37 . SAS