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NAVAL POSTGRADUATE SCHOOL MONTEREY CALIF
COMPUTER SELECTION AND EVALUATION.(U)
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EQ. 3 for real time systems multiprogramming
background batch jobs

$$\text{Average throughput rate} = \frac{\text{(Representative transaction workload + representative batch workload) successfully completed during an evaluation period}}{\text{Wall clock system hrs. expended to process that workload}}$$

EQ. 4

Capability = $\frac{\text{Maximum achievable average throughput rate}}{\text{regardless of the timeliness of outputs over a given time period}}$

EQ. 5

Operational capability = $\frac{\text{Maximum achievable average throughput rate while meeting timeliness requirements}}$

EQ. 6

$$\text{Relative throughput rate} = \frac{\text{Average throughput rate for evaluation 1}}{\text{Average throughput rate for evaluation 2}}$$

EQ. 7

$$\text{Relative capability} = \frac{\text{Capability for evaluation 1}}{\text{Capability for evaluation 2}}$$

EQ. 8

$$\text{Percent unused capability} = \frac{\text{(Capability - average throughput rate)} \cdot 100}{\text{Capability}}$$

EQ. 9

$$\text{Percent throughput rate change} = \frac{\text{Relative throughput} - 1}{\text{rate}} \cdot 100$$

EQ. 10

Turnaround time = Elapsed time in hrs., min. or sec. between arrival of first character of first input at input interface and arrival of last character of final output required by that input at output interface

EQ. 11

Response time = $\frac{\text{Elapsed time in sec. between arrival of last character of an input transaction at input interface and arrival of first character of final output at output interface}}{\text{Turnaround time of a specific job processed in a specific multiprogrammed environment}}$

EQ. 12

Elapsed time multiplication factor (ETMF) = $\frac{\text{Turnaround time of a specific job processed in a specific multiprogrammed environment}}{\text{Turnaround time of the same job processed as the only job in the same system}}$

EQ. 13

Equivalent throughput rate of N independent systems

- = Sum of throughput rates of N systems
- = Throughput rate of system 1 + Throughput rate of system 2 + ... + Throughput rate of system N

EQ. 14

Equivalent capability of N independent systems

- = Sum of capabilities of N systems
- = Capability of system 1 + Capability of system 2 + ... + Capability of system N

APPENDIX B

HARDWARE CHECKLIST

A. Central Processing Unit (CPU)

1. Organization (word and/or byte oriented)

2. Processor storage characteristics:

Real, buffered or virtual processor storage; core or monolithic; amount reserved for firmware; net amount available for operating system and problem programs. Amount of low-speed storage included, if any.

3. Complement of registers

4. Memory cycle time

5. Average "access to processor storage" time

6. Number of words or bytes accessed per cycle

7. Instruction repertoire

8. Instruction mix timing (average execution time)

Example: (5-byte unpacked fields)

a. $c = a + b$

b. $c = a \uparrow b$

c. $c = a + b$

d. Move a to b

e. Compare a to b and branch

Instruction mix should be chosen based on expected use. For instance, if a significant amount of floating-point work is expected, then these instructions should also be timed.

If the arithmetic instructions are performed in the registers, the loading to and storing from registers should be included in the timings.

9. Special power unit required
10. I/O channels
 - a. Number of channels by type (selector, multiplexor, or block-multiplexor)
 - b. Maximum speed of each
 - c. Attachable units (or excluded units)
 - d. Switching capability of attachable units
 - e. Simultaneity of operation between CPU and the I/O units, as well as between the I/O units themselves
 - f. In-board channel (CPU acts as channel processor) or out-board channel (channel processor separate from CPU)
 - g. Channel diagram of proposed system
 - h. Attachable to another CPU
11. Integrated controllers
 - a. Attachable I/O units
 - b. Limitations on which integrated controllers may or may not be core resident
 - c. Degradation of CPU performance caused by the integrated controllers
12. Timers/clocks
 - a. Resolution or precision
 - b. Maximum time accumulation
 - c. Interrupt triggers
 - d. Difficulty in setting
 - e. Time of day or interval timers

13. Power failure protection
 - a. Emergency off-automatic shutdown sequence
 - b. Power fail safe
 - c. Standby or secondary power source
 14. Storage protect capabilities
 - a. Number of separate areas protected
 - b. Fixed areas or software controllable
 - c. Minimum area protectable
 15. Compatibility/emulation features
 - a. Machines emulated
 - b. Software requirements
 - c. Limitations
 16. Expandability
 - a. Other features available
 - b. Maximum storage and channels
- B. Magnetic Tape Units
1. Number of units
 2. Number of controllers
 3. Densities supported, single or dual
 4. 7-Track/9-Track
 5. Operating characteristics: Mounting operation (auto-load or manual), tape cartridge required or usable, fixed or rotatable dial, stress and wear on tape (number of capstans, vacuum column, tension arms)
 6. Continuous or incremental recording
 7. Transfer rate
 8. Start/stop time

9. Rewind time
10. Formula for computing effective speed
11. Error-checking and correcting capability
12. Automatic or manual switching (between CPUs, channels, controllers)
13. Expandability: maximum number of units per controller, controllers per CPU

C. Card Read/Punch

1. Rated speed (reflects maximum speed)
2. Time to process one card (converted to cards per minute, this reflects minimum speed)
3. Card codes supported
4. Number of stackers and capacity of each
5. Number of hoppers and capacity of each
6. Error-checking capability
7. Buffered, interlocking or cycle steal
8. Special features: 51 column, punch-feed-read, mark sense, and so on
9. Capability for sorting, collating, interpreting (card print)
10. Noise level
11. Reliability
12. Controller characteristics and limitations

D. Printer

1. Rated speed (for designated character set)
2. Time to print one line
3. Number of print positions

4. Width of form (maximum and minimum)
 5. Quality of print (single and multiple form)
 6. Character set
 7. Skip speed
 8. Carriage tape specifications
 9. Lines per inch
 10. Noise level
 11. Stacker characteristics
 12. Reliability
 13. Buffered, interlocking or cycle steal
 14. Controller characteristics and limitations
- E. Disk or Drum
1. Capacity
 2. Transfer rate
 3. Access time (seek and rotational delay)
 4. Removable packs or fixed head storage
 5. Special features (such as rotational position sensing)
 6. Channel restrictions (such as attachable only to channel number one, or only device on the channel)
 7. Controller characteristics and limitations
 8. Expandability
 9. Reliability
- F. Operator Console
1. CRT or printer
 2. Keyboard
 3. Speed
 4. Width of display

5. Number of display lines visible to operator
6. Character set supported
7. Location relative to CPU and I/O units
8. Noise level
9. Reliability
10. Special paper or stock form
11. Stacker for paper
12. Ribbon required-expected life

G. Paper-Tape Reader/Punch

1. Speeds (transfer rate, start/stop time)
2. 7- or 9-channel tape
3. BCD, EBCDIC or ASCII code
4. Feed and take-up reels or fanfold
5. Rewinding required
6. Checking capability
7. X-on and X-off required
8. Compatibility with source or destination of tape
9. Splicing considerations
10. Reliability

H. Telecommunications

1. Controllers (data adapters)
 - a. Number of lines supported
 - b. Speed of transmission
 - c. Leased line or dial-up
 - d. Synchronous or asynchronous
 - e. Types of terminals supported
 - f. Interchange code supported

g. Features supported (such as paper tape, answer-back, auto-call, multiple-record transmission, polling)

h. Buffered

i. Duplex or half-duplex transmission

j. Error correction/recovery

2. Modems - See above and below

3. Communication facility

a. Leased or dial-up

b. Multiplexed line

c. Duplex or half-duplex transmission

4. Terminal

a. Type of display (CRT or hard copy)

b. Input modes (such as keyboard or tape cassette)

c. Speed

d. Width of display

e. Number of lines visible to operator

f. Interchange code used

g. Special paper or stock form

h. Impact or thermal printer

i. Multiple copies

j. Paper-stacking facility

k. Intensity adjustment

l. Visibility of cursor

m. Error correction/recovery

n. Hard-wired or acoustic coupler

o. On-line or off-line transmission

I. Other Equipment

Many other types of equipment may be available to attach to or be used in conjunction with the computer system. Each requires various considerations regarding performance, suitability for the purpose, compatibility with other units, reliability, operator interface and physical characteristics.

Listed below are some of these types of equipment:

1. Microfilm/microfiche
2. Plotters/graphics
3. OCR scanner
4. Array processor
5. Audio response
6. MICR
7. Manual or automatic switching units

Many other considerations such as power requirements, air conditioning, humidity control, floor space, and so on, apply to all the hardware.

APPENDIX C

SOFTWARE CHECKLIST

A. Operating System

1. Resident device(s)
2. Amount of direct-access storage dedicated to operating system and work space required
3. Processor storage reserved for operating system
4. Support for anticipated I/O devices
5. Extent of multiprogramming capability and limitations
6. Proposed method of card I/O and print processing
(SPOOL)
7. Preexecution I/O device setup
8. Ease of operation
9. Acceptability of operator messages
10. Access methods available
11. Virtual storage-optional or required
12. Support of automatic switching between channels
13. Compatibility or emulation support-capabilities and limitations
14. Complexity and capability of job-control cards/
language
15. Job-accounting facilities
16. Operating system and hardware performance statistics
17. Telecommunication facilities (Remote Job Entry, direct data entry/retrieval, time-sharing, and so on)
18. Clarity of error codes/messages

19. Data-base management features
 20. Facilities for user program library
- B. Compilers/Assemblers
1. Languages supported
 2. Adherence to national standard languages and features
 3. Processor storage required for execution
 4. Work space required on direct-access storage
 5. Maximum program size allowable (number of source statements)
 6. Devices not supported
 7. I/O addresses absolute or generic
 8. Subroutine libraries available
 9. Suitability of languages to meet expected needs
 10. Telecommunication features
 11. Clarity of diagnostic codes/messages
- C. Sort/Merge
1. Maximum/minimum file size
 2. Maximum/minimum record size
 3. Fixed/variable record lengths
 4. Blocking
 5. Number of fields in key-maximum key size
 6. Devices used/required/supported
 7. Formulas/tables to compute processor storage and I/O storage required
- D. Utility Program
1. List of utility programs available
 2. Completeness of list to meet needs

E. Performance

1. Estimate sort timings
2. Estimate compile/assemble rate
3. Estimate operating system overhead
4. Estimate processing time of problem programs
5. Estimate compatibility/emulation performance
6. Predict total throughput of work load including operator functions and multiprogramming performances
7. Benchmark representative sample to confirm performance
8. Use of simulation where advisable

F. System Preparation Requirements

1. SYSGEN plan
2. On-site or remote
3. Minimum system required to perform SYSGEN
4. Amount of time required
5. Degree of testing needed
6. Vendor assistance
7. Education required

G. Software Availability/Reliability

1. How long in use by other installation (or when available)
2. Other users' experience
3. Software maintenance
 - a. Normal period between updates
 - b. Difficulty to maintain
 - c. Availability of vendor assistance

4. Quality and completeness of documentation

5. Computer program patent considerations

H. Vendor-Supplied Application Programs

1. Extent of library

2. Programs required

3. Programs not required but of potential value

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