HEWLETT PACKARD

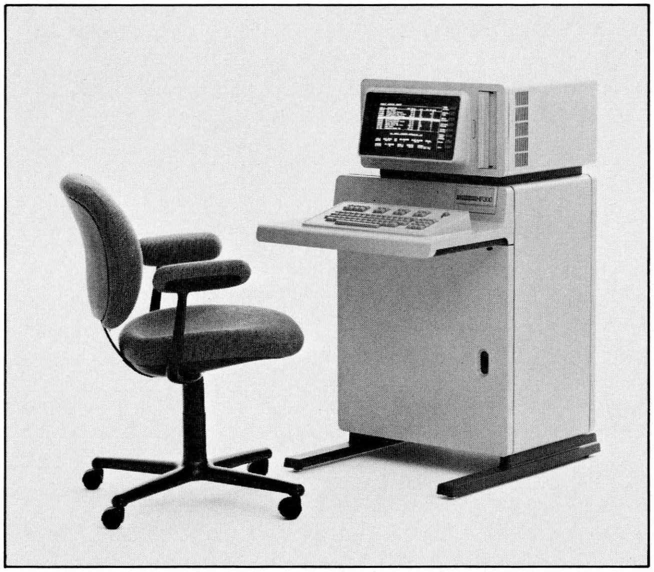
HP 300 Computer System Performance

HP 300 Performance

Choosing the right system with the right performance capabilities is critical to the success of most applications. To adequately evaluate a system, the system analyst needs to know how much of the workload anticipated can be processed, and how quickly. To help in this evaluation and to demonstrate the range of performance available with the HP 300 Computer System, several comparable tests were conducted to measure throughput and response times for representative applications. The information presented here is a collection of these measurements aimed at characterizing various key aspects of the performance of HP 300. (The goal in designing these tests was to duplicate the level of performance routinely attainable in normal application environments, rather than carefully selecting programs which would have given results better than those shown.)

Configurations of HP 300 have been tested with main memory from 256 Kbytes to one Mbyte, and up to 16 display terminals. This represents a broad range to select from in tailoring a system to meet current performance needs and in recognizing cost-effective growth paths for increasing future system demands. To additionally maximize success in implementing applications on HP 300, system performance and applications design consulting is available from HP's worldwide staff of System Engineers; and customer training courses with comprehensive documentation are offered at HP training centers.

In the first section, Multiterminal Transaction Processing, measurements are presented for three application examples that are representative of the range of multiterminal applications that are likely to be run on HP 300. The second section, Additional Performance Fundamentals, contains information on specific areas of processing performance that can be used in deriving a more complete approximation of HP 300 performance. The third section, Combined Processing Using Multiprogramming, presents two multiterminal transaction processing programs and a lower priority set of operations (including sorting, merging, printing, and data base access) all running concurrently. These tests demonstrate HP 300 in a representative environment which includes both multiprogramming and multitasking operations. All tests were made using an HP 300 with the



HP 300 Computer System

standard built-in system disc. (Tests made using the HP 7906 as the system disc instead, result in an average performance improvement of at least 15%.)

Multiterminal Transaction Processing

Each of the first three examples was implemented as a multitasking program following the recommendations given in the "HP 300 Multiterminal Applications Guide (31000-90005)" for developing efficient multitasking applications. Each application was tested by itself on an HP 300 varying memory size and the number of terminals (each operated at 9600 baud). In each of these scenarios, user input times were chosen to be typical for the application but simulating a "worst case" situation where each user is performing at 100% efficiency.

Example 1: Interactive Transaction Processing
This example makes extensive use of the file system and other time and resource consuming sytem services. It is typical of many of the highly interactive applications that will be used on HP 300. The following form was displayed:

Line	Product	Quantity	Price

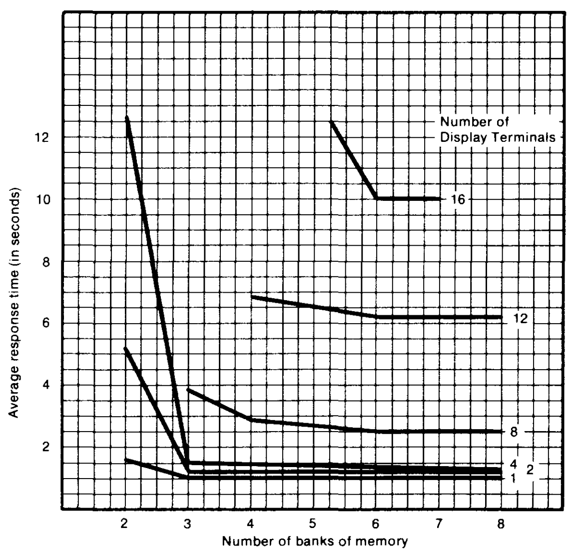
As each line item was entered using this form, complete item information was constructed on the lower part of the same display by the system:

Line	Product	Operation	U/M	Quantity	Price	Total
001	11111A	Wrightsons Air Filter	EA	5	3.50	17.50
002	4444A	C47-01 Gauge Rings	DOZ	1	27.49	27.49
003	55555B	Filter Paper, Blue	PAK	2	1.75	3.50

Transaction: The next line number was automatically displayed in the form; after the user typed in the remaining fields and pressed the ENTER key, the product number was verified to be one that was present in a keyed sequential product file, numeric and alpha checking was performed on the fields and the price was verified to be within limits contained in the product file; all information for the line item was constructed from the product file and displayed, as well as being entered into a sequential transaction file (all files were appropriately locked and unlocked to allow shared access from multiple terminals); the fields in the form were then cleared, ready for the next transaction to be entered. (For the simulation, the interval between clearing the fields and pressing the ENTER key varied randomly between 2 and 10 seconds at each terminal to simulate typing time of an efficient operator.)

Response Time: The interval between the time the ENTER key was pressed and the time the fields were cleared, ready for the next transaction to be entered.

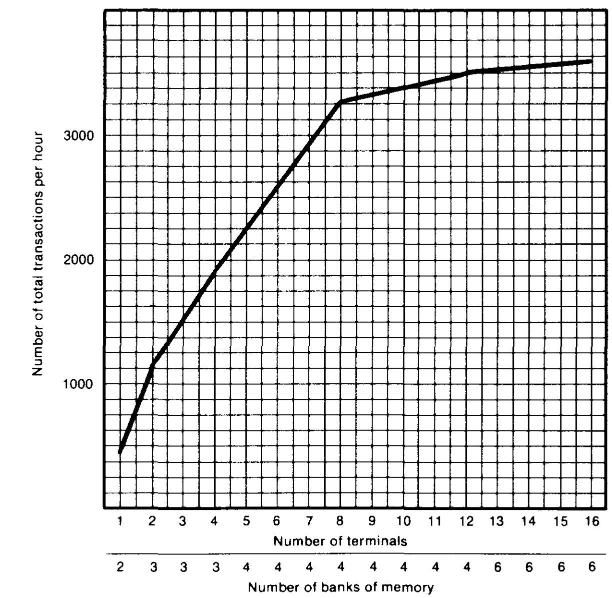
Response Time: Example 1



For these complex transactions, performance remained favorable up through eight terminals. (For example, the average response time for eight display terminals operating simultaneously on an HP 300 having three banks of memory was 4.0 seconds. Adding a fourth bank of memory reduced the response time to 2.8 seconds for Example 1.)

Beyond eight terminals, response time increased to the point where each additional terminal added very little to the total number of transactions possible per hour. (This is made clear by the graph below of Total Transactions per Hour for Example 1.) Of course, if the average time delay between transactions were increased, a greater number of display terminals could be effectively used; however, the total throughput of transactions for the system would not increase significantly.

Total transactions per hour: Example 1



Example 2a: Simple Forms-oriented Transaction Processing

This application example represents a high throughput test of multiterminal transaction processing on HP 300. It allows the maximum number of terminals that can be supported for any given memory size with fast response time and high transaction throughput. It is typical of many data entry applications (orders, inventory, customer information, etc.) where the need to access files is minimal at the input phase of the application. This display form was used, and is representative of this type of application.

Customer #

Customer Name | Address Line #1 | Address Line #2

Customer City | State | ZIP Code | Telephone #

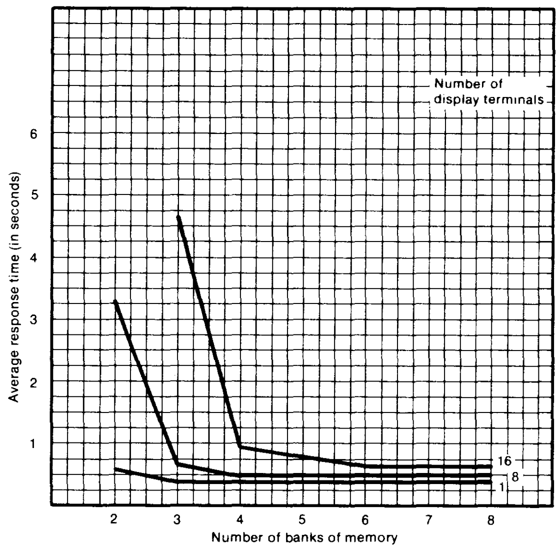
Credit Limit | Salesman

*One bank equals 128 Kbytes. The standard HP 300 has two banks, 256 Kbytes; and can be expanded to eight banks, totaling one Mbyte.

Transaction: Data was typed into each of the fields and the ENTER key was pressed; HP 300 performed limited checking on the fields; all fields were written into a sequential transaction file as a single entry; the fields were then cleared by HP 300 making the form ready for the next transaction. (For the simulation, the interval from the clearing of the fields to the pressing of the ENTER key varied randomly between 20 and 50 seconds at each terminal to simulate typing time of an efficient operator.)

Response Time: The interval between the time the ENTER key was pressed and the time the fields were cleared, ready for the next transaction to be entered.

Response Time: Example 2a



For simple forms-oriented transactions, these results show favorable response time through the maximum of 16 display terminals.

Example 2b: Simple Question and Answer Transactions
This application example performed the same function as Example 2a, but was implemented instead as a series of questions and answers (one question and answer for each field). This is typical of the way many interactive applications have been implemented in the past.

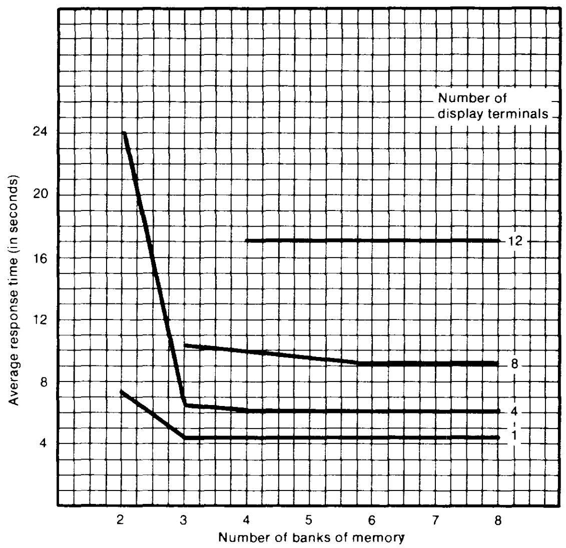
Response times were comparable to those presented for Example 2a and remained very favorable through the maximum of 16 terminals. (The total number of complete transactions that could be performed per hour is slightly less than for Example 2a due to the added time to display each question.)

Example 3: Output Intensive Processing
This example is representative of multiterminal applications which require large quantities of information to be displayed. Inquiry applications that frequently display complete customer information, vendor orders, or inventory parts lists are examples of this kind of application.

Transaction: A short inquiry was typed on the display and the RETURN key was pressed; a display full of information resulted, and the terminal was made ready for the next inquiry to be typed. (For this simulation, the interval from the time the display was full until the time the RETURN key was pressed varied randomly between 20 and 50 seconds to simulate reading and typing time.)

Response Time: The interval between the time the RETURN key was pressed and the time that the screen was full, ready for the next inquiry to be typed.

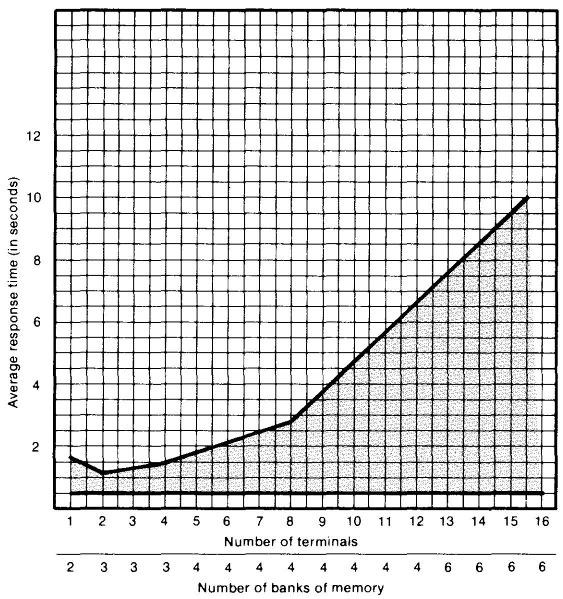
Response Time: Example 3



Range of Response Times:
The Specific Application is the Key
System performance in a transaction processing environment is the result of a combination of factors, including system hardware configuration and user application implementation. To provide a high performance system, Hewlett-Packard has optimized HP 300 to allow maximum throughput and minimum response time. However, the factor that cannot be anticipated is your specific application. The application (or mix of applications) will determine the actual response time and throughput HP 300 will deliver.

The range of HP 300 performance within two diverse application loads is illustrated below. The lower limit of the shaded area represents the average response time for a light application load. The transaction activity for this application involved simple forms-oriented data entry (Example 2). The upper limit represents a more demanding transaction load (Example 1). These transactions involved extensive file access to enter, inquire and update information (with locking and unlocking of shared files). Total memory size was increased along with the number of terminals, as indicated below, to represent typical multiterminal configurations of HP 300.

Response Time Range: Example 1 and Example 2



Additional Performance Fundamentals

This section presents a wide range of additional HP 300 performance characteristics. This information is useful in deriving more detailed approximations of total performance, which include the various activities typical in the day-to-day use of HP 300.

Test

HP 300 currently offers both Business Basic/300 and RPG II/300 compiler-based languages. Once a program has been entered, a single-key TEST function can automatically compile, segment, link and initiate a test execution of the program. (Program development is performed solely from the IDS on HP 300.) The time that it takes to perform this TEST function is indicated in the following tables:

Business Basic/300:

Program Length	MEMORY (Total Number of Banks)			
	2	3	4	6
200 lines	4:35	2:13	1:57	1:46
1500 lines	9:40	5:34	4:49	4:37

TEST Time (minutes:seconds)

RPG II/300

Program Length	MEMORY (Total Number of Banks)			
	2	3	4	6
125 lines	3:13	1:55	1:34	1:20
280 lines	4:03	2:25	2:09	1:54
1060 lines	10:42	7:54	7:34	7:27

TEST Time (minutes:seconds)

These results show that increasing memory size to three and four banks improves TEST performance, and that TEST speeds are dependent on program size.

These times were developed for HP 300 running the TEST function by itself. If other computing were being performed concurrently, these times would increase. For example, the following results are from the TEST of the 200-line Basic program. At the same time, a multi-terminal application example was run at a higher priority.

Concurrent Application	Number of Terminals		
	0	4	8
Example 1	1:57	5:23	37:00
Example 2	1:57	2:25	3:04

Time to TEST (minutes:seconds)

Sort

Business applications typically require large amounts of sorting in the processing of files. HP 300's sort utility has the following performance characteristics. These tests used records that each contained 100 characters of data and were sorted by three keys (eight characters per key).

No. of Records	MEMORY (Total Number of Banks)			
	2	3	4	6
1000	:56	:49	:46	:44
2000	2:23	2:06	2:03	1:58
4000	5:51	5:17	5:14	5:05

SORT Time (minutes:seconds)

In these cases, only slight increases in performance were realized through the increase in memory size. Sort speed was dependent on the number of records being sorted. Sort speed is also dependent on record length as indicated by the following results. These sorts were run on an HP 300 having four banks of memory.

No. of Records	RECORD LENGTH (in bytes)	
	100	256
2000	2:03	5:40
4000	5:14	12:30

SORT Time (minutes:seconds)

These times were developed for HP 300 running the Sort function by itself. If other computing were being performed concurrently, these times would increase. For example, the following results are for a 2000 record sort by three keys, using an HP 300 with four banks of memory. At the same time, a multiterminal application example was run at a higher priority.

Concurrent Application	Number of Terminals		
	0	4	8
Example 1	2:03	4:28	26:00
Example 2	2:03	2:13	2:32

SORT Time (minutes:seconds)

Merge

As one example of the Merge utility, two 2000 record files (100 characters per record) were merged using three keys. The resulting time to merge was 1.00 minute on an HP 300 with two banks of memory.

File System

The file system of Amigo/300 provides both sequential and keyed access methods. It also supports a wide range of file structures: sequential, relative, keyed sequential, direct, library, memory and primitive. The following test results are representative of the general performance of the file system. All tests were made on an HP 300 with two banks of memory.

Record Size (in bytes)	100		256	
Operation	Read	Write	Read	Write
File Structure/Access Method:				
Sequential/Sequential	13	19	18	26
Keyed Sequential/Keyed	96	154	115	194
Direct/Keyed (500 Home Blocks)	89	154	88	157

Time to Read/Write 1000 Records (in seconds)

Print

HP 300 currently supports up to two HP 2631 printers. The HP 2631 has a nominal speed of 180 characters per second, which varies slightly dependent on line length. In actual testing, the time required to print a 100-line report on HP 300 with an average line length of 80 characters is 53 seconds.

In running Example 1 with eight terminals and four banks of memory, the time required to print (with a lower priority) the same 100-line report increased to 3 minutes and 28 seconds.

Flexible Disc Transfers

On an HP 300 having two banks of memory, the time required to write a file of information to the flexible disc and to read a file of information from the flexible disc tested as follows:

Amount of Information	Write	Read
38 Kbytes	19	13
102 Kbytes	39	26
384 Kbytes	129	86

Time (in seconds)

System Build

System Build is used for reconfiguring the hardware and software of HP 300 and its attached peripherals. It is also used in the updating of system software. (Both of these functions are performed infrequently.) System Build operations are performed when there is no other activity on the system. A complete System Build for the updating of system software typically requires 2.5 hours (on an HP 300 with two banks of memory). Less time is required by System Build in reconfiguring hardware and software on an HP 300, dependent on the number of configuration changes being made.

System Disc Capacities Available to Users

HP 300 can have a built-in 12 Mbyte disc as its system disc. When the system software storage requirements are considered (including temporary additional storage needed by the system during such activities as TEST), approximately 7.3 Mbytes of storage remain for storage of user programs and data. (This figure assumes that all standard software as well as RPGII/300, Business Basic/300 and Image/300 are included on the system.)

Using the alternative HP 7906 as the system disc instead of the built-in disc, changes user capacity to approximately 14.9 Mbytes. Up to two other discs can optionally be added to HP 300. The HP 7906 (20 Mbytes), HP 7920 (50 Mbytes), and HP 7925 (120 Mbytes) discs can be used, for a combination of up to 260 Mbytes of disc capacity.

During System Build an additional 4 Mbytes of temporary disc capacity is used for construction of the new set of operating software. (A backup version of the operating software could be left on the disc after System Build, but requires the additional 4 Mbytes.) On smaller configurations, it may be necessary to temporarily off-load user files and programs to make available the additional disc capacity needed by System Build.

Typical Program Storage Requirements

Figures are shown below for the typical program storage requirements of Business Basic/300 and RPGII/300 programs in either a program development environment (i.e., all program files, including the source file, needed to develop, modify and run) or an execution only environment (i.e., only those files required to actually run the program; the source file and others are not included):

	Program Length	All Program Files	Execution Files Only
Business Basic/300	200 lines	350	70
	1500 lines	1100	102
RPG II/300	125 lines	213	72
	280 lines	266	72
	1060 lines	563	104

Storage Requirements (in Kbytes)

Note that any requirements for data storage and temporary files created by programs during execution are not included in these figures.

Combined Processing Using Multiprogramming

Example 1 and example 2 were run at the same time to give an indication of the effect on performance of running different multiterminal applications at the same time. This was a test involving both multiprogramming, since example 1 and example 2 were each independent programs; and multitasking, since each of the terminals was run by a separate task with the example programs. In addition, as a test of greater processing concurrency, a standard job was defined and run as a batch job at the same time at a much lower priority.

Test Criteria

Throughput: To measure throughput, a *standard job* was used in all tests. It was made up of the sequential running of each of the following:

- Execute program to print a 100-line report.
- Sort a 2000 record file by three keys.
- Merge two 2000 record files by three keys.
- Execute a program to perform a representative mix of 250 Image/300 data base accesses.

  This job was run repeatedly throughout each test and the throughput calculated in terms of *jobs per hour*. Since the same job was used in all tests, it is valid to compare the throughputs of the various tests described here. Of course, users' jobs would be different and would produce different throughputs when measured in these units.

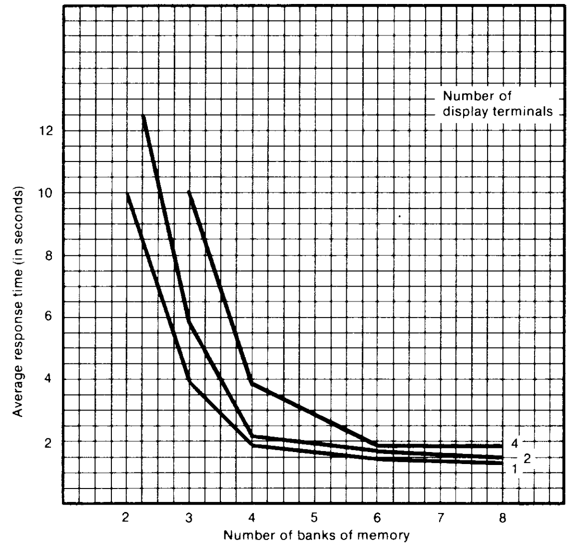
Response Time: The interval between the time the ENTER key is pressed to enter a transaction and the time that the user can begin to type the next transaction. The graphs show the average response time for all terminals running each of the two Example transactions. (Terminals were run at 9600 baud.)

Transaction Processing: Two types of interactive transactions were tested. The first used transactions that require more complex processing, making extensive use of file accesses and other system resources to verify and present information to the user (Example 1). The second used simple forms-oriented transactions to enter a full form of information into a sequential file (Example 2).

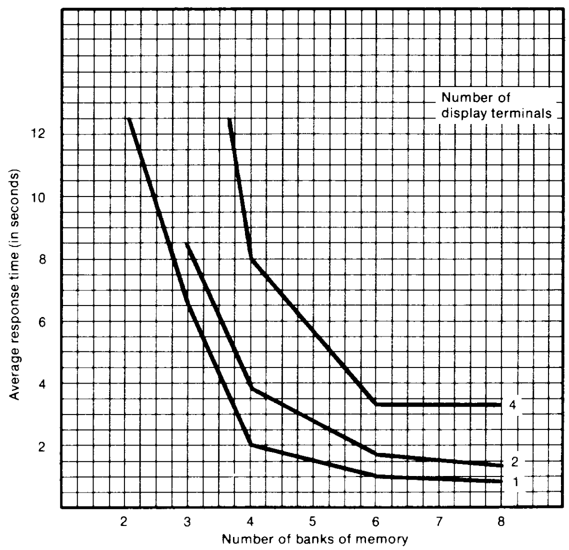
Testing: The complex transaction (Example 1) was run continuously at a high priority on half of the terminals, while the simple forms-oriented transaction (Example 2) was run at the same time with a lower priority on the other terminals. The *standard jobs* were run repeatedly as a still lower priority along with the transaction processing. Throughput for the *standard jobs* and response time for the terminals were measured.

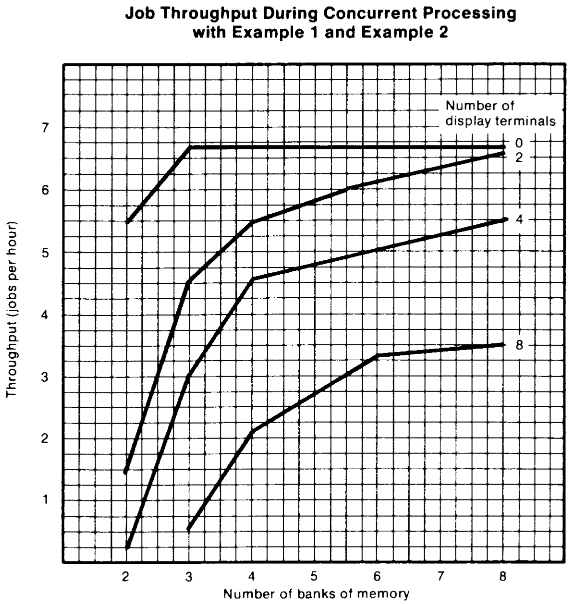
System: These tests were performed on an HP 300 using the built-in system disc. The total number of terminals was increased in pairs running the two transaction types as indicated by the graphs below:

Response Time: Example 1 During Concurrent Processing with Example 2 and Standard Job



Response Time: Example 2 During Concurrent Processing with Example 1 and Standard Job





As the number of terminals (half of the terminals performing Example 1 and half performing Example 2) increases, the total throughput of the standard job, running at a lower priority, decreases as shown in the graph above. (Running two standard jobs concurrently with no terminals on an HP 300 with four banks of memory, increased throughput from 6.7 to 9.2 jobs per hour.)

HEWLETT hp PACKARD

1507 Page Mill Road, Palo Alto, California 94304

Printed in USA 9/78 5953-3705