

# Computer Performance Considerations

## An evaluation of the DEC MicroVAX II and the HP MICRO 3000XE Computers

*A comprehensive benchmark highlights how specific computer system components contribute to performance in on-line transaction processing applications.*

Comparative performance evaluations of computer systems often fail to yield definitive, or even meaningful, results in a business application environment because of oversimplification of measurements and inadequate controls for bias. One common error is to compare only specification-related indicators, such as MIPS, and to exclude other factors that provide a more accurate measure of work completed. Although processor speed is important, MIP ratings do not necessarily indicate the amount of real work a computer can accomplish; the processor may be occupied with various system management tasks that adversely impact performance. The operating system, database management system, and architecture can have as much impact on performance as the processor itself.

### Benchmark answers questions

A true comparison of computer system performance in a business environment must measure work completed and must compensate for vendor-specific biases. The accepted procedure for establishing comparability is to set up a rigorously defined benchmark.

Hewlett-Packard's Capacity Planning Center has run such a benchmark with the DEC MicroVAX II and the HP MICRO 3000XE computers. The test recreated a real-world data processing situation using a widely-installed transaction processing application and a test database.

The goal of the benchmark was to measure the work accomplished by each computer in terms that relate to a business environment. Transaction throughput and response time are the most realistic and meaningful measures in this environment. How many transactions are actually processed in a given time frame? How quickly does the system respond to user requests? Does increasing user demand on the system cause erosion in either throughput or response time? These are the questions the benchmark set out to answer, because they are the questions asked by customers concerned with performance in a business environment.

Beyond merely measuring work accomplished, it also is necessary to identify the specific system components affecting the operation of the machines. This makes it possible to pinpoint individual design factors that contribute to superior performance.

Stringent measures were taken to assure an unbiased benchmark. An independent performance consultant was employed to tune the DEC system for optimum performance in a transaction-intensive application. The consultant characterized the project and its results as verifiable and consistent. The application was purchased from a value-added software vendor who also helped establish guidelines for user interaction.

### Hardware considerations

The benchmark was set up to test comparable machines running a transaction-intensive application designed for both systems. Entry-level computers from DEC's VAX line and from the HP 3000 family were selected.

Both hardware configurations were based on what typical competitive bids might be for a customer requiring a 16-user interactive system. The DEC system was tuned for optimum performance according to instructions from the performance consultant. An HP performance expert tuned the MICRO 3000XE computer.

#### Test Results

The benchmark results demonstrated that transaction throughput was 28% greater and response time approximately 50% faster on the HP MICRO 3000XE computer (See Figures 2 and 3). As the chart reveals, response time of the DEC system deteriorated more rapidly than the HP system as the benchmark reached its capacity of 16 active users.

## System Configurations

SPU	DEC MicroVAX II (BA 123)	HP MICRO 3000XE
Memory	16 Mb	6 Mb
Ports	2 DHV11 (16)	2 ATP/M (16)
Disc	3 RD53 213 Mb total	1 7957, 1 7958 211 Mb total
Tape	TK50	9144A
Terms	16 VT220	16 2392A
Op System	MicroVMS	MPE
Hardware & essential s/w cost	\$93,505*	\$82,682*
3-year cost of ownership	\$126,421*	\$96,746*

\*U.S. list prices for products and services at the time the benchmark was performed.

Figure 1

For the benchmark, both system configurations were selected to make them as equivalent as possible and thus ensure comparability on a hardware basis.

## Configurations: main memory, operating system, disc

The MicroVAX II computer, running the 32-bit VMS operating system, was tested with both 9 Mb and 16 Mb of main memory. The 9 Mb configuration proved insufficient, causing higher I/O levels as memory space was swapped among users. Consequently, the 16 Mb configuration, the maximum possible on the DEC system, was implemented to assure an unbiased benchmark.

The HP MICRO 3000XE's 16-bit MPE operating system performed throughout the benchmark with 6 Mb of memory. This configuration was sufficient because MPE is designed specifically for commercial applications.

Disc storage was equivalent for both systems. The MicroVAX II computer provided 213 Mb in three discs, with one controller. The MICRO 3000XE had two discs, each with its own integrated controller, for a total capacity of 211 Mb.

Both systems supported 16 user terminals via RS-232 connections.

## Software selection

One of the major benchmark design considerations was the selection of application software. To reflect the realities of the market and the work environment, a commercially available solution tailored for both the MicroVAX II and the MICRO 3000XE computers was required. This ensured that the application performed optimally on each system.

It was also important that the package represent a real commercial transaction processing environment. This meant a highly interactive application handling large numbers of transactions with a heavy demand on the database.

The software selected because it meets these requirements is a widely installed FORTRAN-based transaction processing application that incorporates each computer's network database management system (DBMS on DEC, TurboIMAGE on HP). The supplier also provided a test database felt to be representative of a customer's environment. Because both systems used the same data, comparability was assured.

Finally, the tests executed the same transactions on each system. As expected, some dialogue differences did exist between the software implementations. These differences involved screen design and had a slight effect on system performance. To equalize the differences, input and think time biases were controlled using automated testing software. This emulates user transactions and makes it possible to repeat the tests accurately.

## Comparison and results

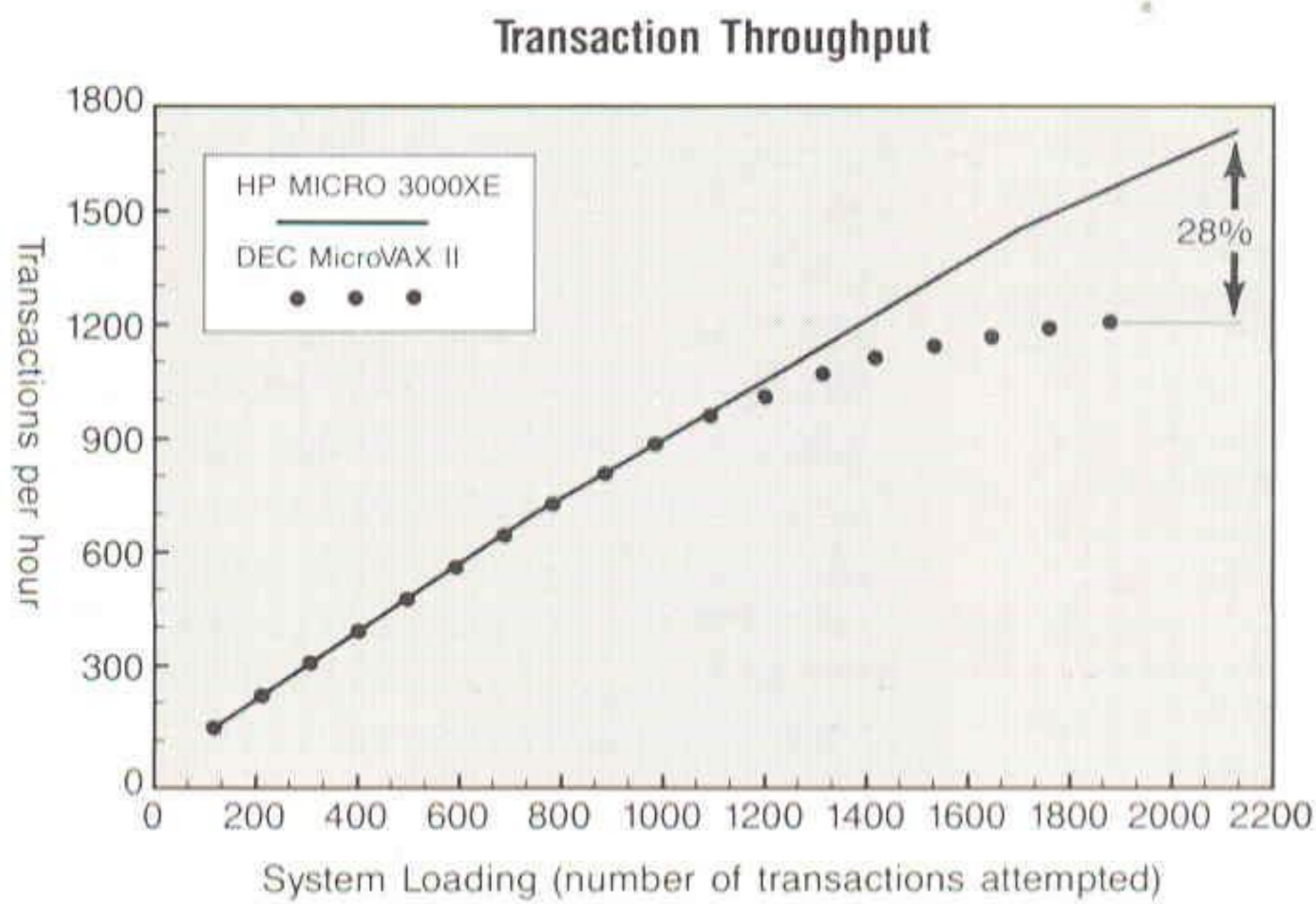
In a business environment, work is defined in terms of transactions—a logical, discrete unit of work such as creating a purchase order or paying an invoice. Therefore, transaction throughput, the hourly rate at which transactions are finished, is the primary measure of work actually accomplished. System load, or the number of users and applications interacting simultaneously with the system, is also important. If the system slows down with additional users or processes, the amount of work that can be done decreases.

Response time equals elapsed time between a user's initiation of a transaction and subsequent response by the computer. In other words, when data is requested, how long does it take the system to find it and display the next prompt?

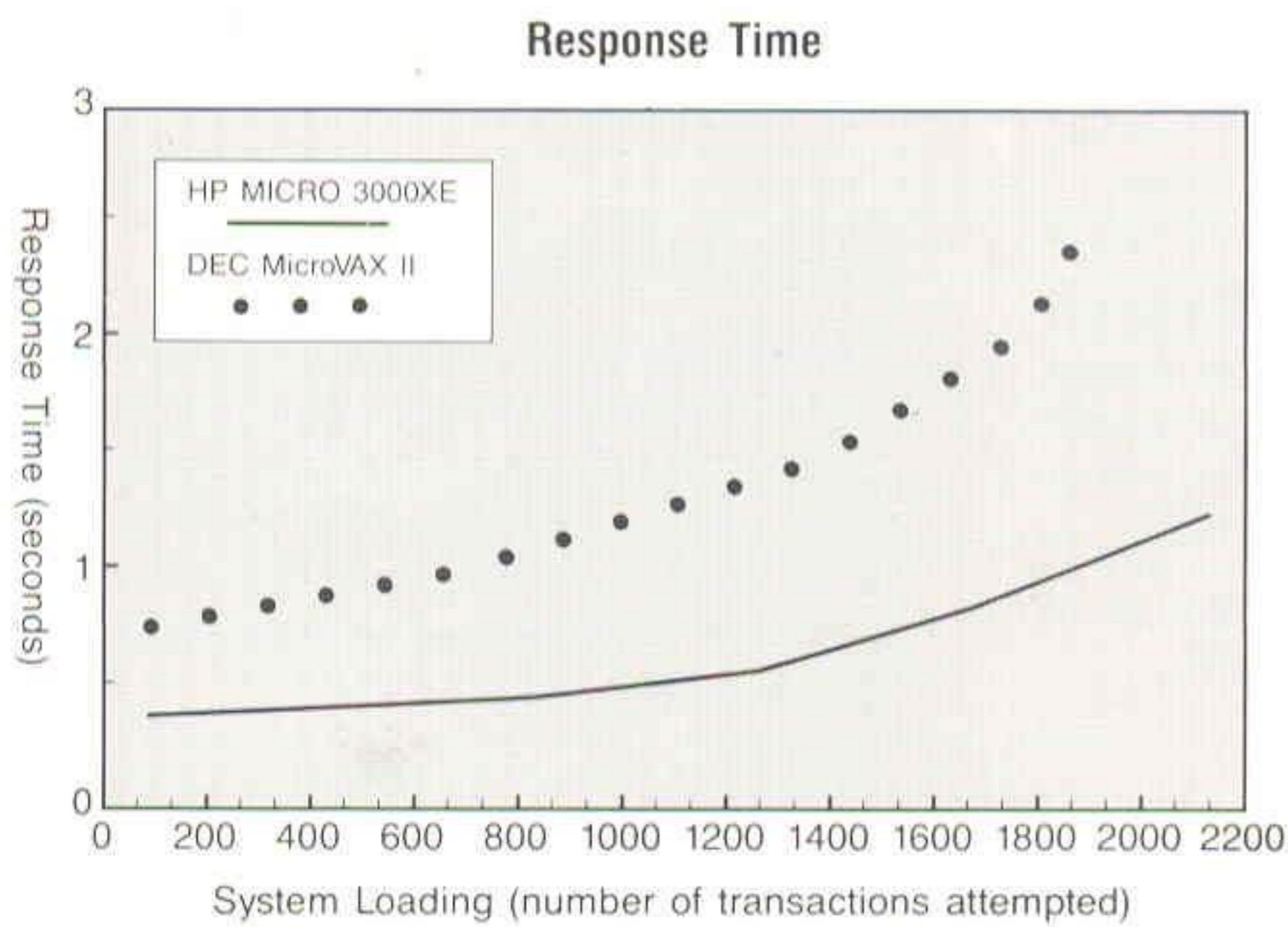
Typically, the more transactions attempted, the slower the response time to the individual user, as indicated in Figure 3. This is an important factor in multi-user business environments where large numbers of transactions are performed on an hourly basis.

Based on these performance criteria, the benchmark yielded some interesting results:

- Transaction throughput for the HP MICRO 3000XE is 28% greater than that of the DEC MicroVAX II computer—the HP system does 28% more work.



*Figure 2*  
Throughput on the DEC MicroVAX II computer levels out around 1300 transactions per hour, typical for a system which has saturated. Although at this system load the HP MICRO 3000XE computer is nearing saturation, transaction throughput clearly is superior (by 28% in fact). Disc caching and dedicated controllers (not available on the DEC system) are primary contributors to this high transaction throughput rate.



*Figure 3*  
Response time is another key measure of performance in any computer system. This benchmark revealed that not only is absolute response time better on the HP system, but, just as important, the rate of degradation was lower as more users were added. Note that at 1 sec. response time, for example, the DEC machine processes about 700 transactions while the HP system handles in excess of 1800.

- Absolute response time is approximately 50% better with the MICRO 3000XE computer—it responds to users two times faster than the DEC system.
- Response time degradation is not as pronounced on the MICRO 3000XE computer as more users are added—from the first to last data point (Figure 3), degradation ranges from 0.4 to 1.4 sec. for the HP system and 0.75 to 2.25 for the DEC system.

### Key performance factors

Disc caching, disc subsystems, database management system, operating system, and the integration of these components contribute to the overall performance of the HP MICRO 3000XE computer. Several of these factors also affect cost, resulting in an excellent price/performance ratio for the system.

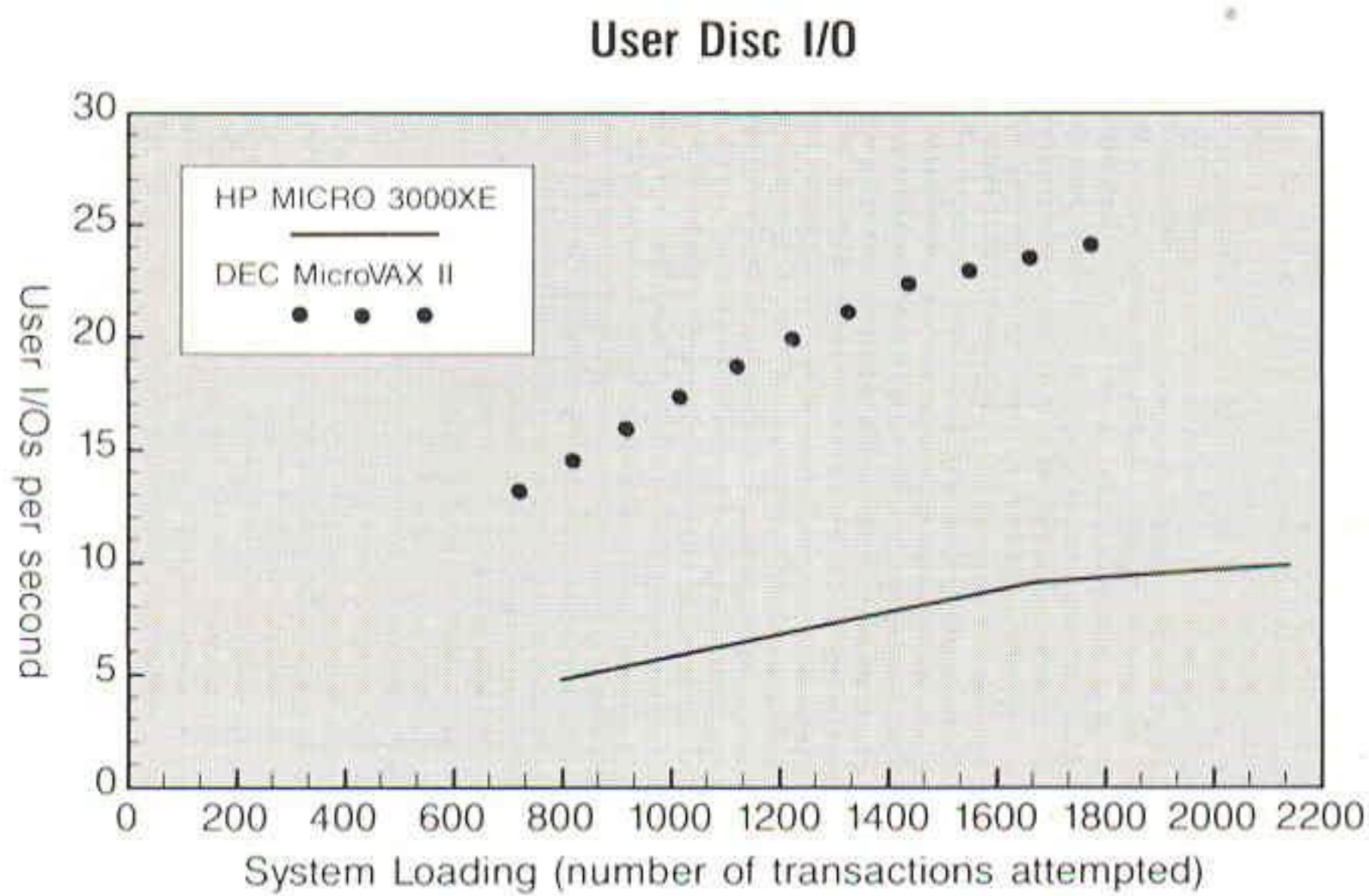
Disc caching, an extension of the MPE operating system, enables the HP computer to achieve a high transaction throughput rate by retrieving not only the information requested, but also information that logically will be requested next. This eliminates the need to return to disc memory for each user request. Reducing the I/O's to disc memory means that more work can be completed in less time. Disc caching is not available on the DEC system.

A second contributor to performance is the disc subsystem. Because HP builds a controller into each disc drive, queueing is reduced. Queueing is simply a bottleneck that occurs due to insufficient data channels. When a user asks for information, the operating system directs the request along a data channel to the place on the disc where the information resides. With only one channel, as is the case with the DEC system, only one request can be processed at a time. Other requests back up, or queue, waiting for the channel to clear. By having a dedicated controller for each disc drive, the MICRO 3000XE computer provides more channels between the disc and main memory, thereby improving the transaction I/O rate.

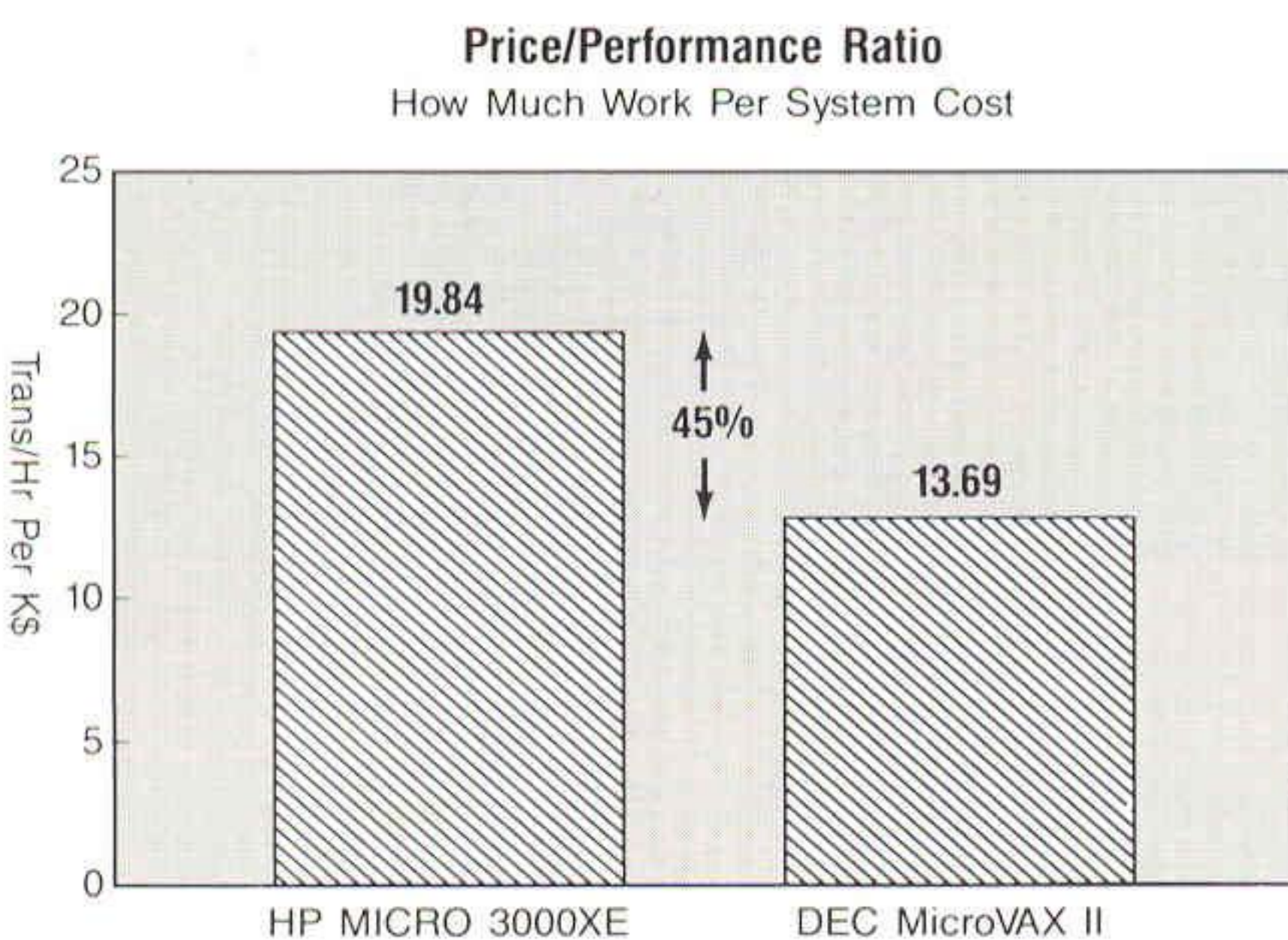
For the user, this means quick retrieval of information. Consequently, it contributes to higher transaction throughput because less time is spent waiting for the computer to respond to a request.

Additional controllers can be purchased for the MicroVAX II computer, and would increase performance by approximately 15%. However, the consultant did not recommend additional controllers for this benchmark due to price/performance considerations.

Differences in the two operating systems also affect performance. DEC's VMS is a general purpose operating system that must be tuned for business applications. The directory size, block transfer sizes, and the amount of memory allocated to each user (as well as other parameters) were adjusted for the benchmark.



**Figure 4**  
An important factor in throughput is the number of disc I/O operations. The DEC system had three discs which shared a single controller, while each of the two HP discs had its own controller. This fact, plus the disc caching feature which significantly reduces the number of disc seeks, accounts for the more effective disc I/O and consequent greater throughput of the HP system.



**Figure 5**  
The number of transactions per hour per dollar (or price/performance ratio) is a sound basis for evaluating a system. The 12% lower list price and 28% transaction throughput advantage of the HP MICRO 3000XE computer translate into a 45% price/performance superiority over the DEC MicroVAX II computer.

Because the Hewlett-Packard MPE operating system is designed specifically for interactive business applications, very little tuning was required for the benchmark. The 16-bit stack architecture incorporates an intelligent algorithm that swaps data between the disc and main memory with minimal adverse impact on overall system performance. Additionally, the database management system has numerous design features that contribute to superior transaction throughput. Features such as a multi-threading capability so multiple users can access the same database simultaneously, buffering mechanisms to reduce disc I/O, and a programmatic locking feature that lets programmers define locking levels to ensure database integrity yet facilitate a high level of user concurrency.

Although transparent to the user, these features contribute to both higher transaction throughput and better response time.

### Price/performance

The net result of these performance factors is a better price/performance ratio for the MICRO 3000XE computer. With the HP system, all software necessary for this application is included. For the DEC system, five critical software packages\* must be purchased separately. As configured, the purchase price of the HP system is 12% lower than the DEC system—\$82,682 VS \$93,505 (U.S. prices).

Also contributing to lower cost is the incorporation of advanced chip technologies. Use of HP's proprietary NMOS III technology and 1 Mb RAM chips has reduced CPU size to a single chip, replacing several boards. For the user, this delivers a small, compact computer for the office, with reduced electrical requirements and minimal heat dissipation. Further, the reliability of the components enables HP to offer low maintenance costs.

The three-year cost of ownership for the MICRO 3000XE is 28% lower than that of the MicroVAX II computer. This cost is based on the list price of the system plus support for the first three years.

### Conclusions

The benchmark clearly illustrates that in a transaction-intensive business application users can complete more work with the HP system than with the DEC system, both in terms of transaction throughput and absolute response time.

Added to the cost benefits that result from its application-specific operating system, bundled software, and advanced technologies, the HP MICRO 3000XE computer offers 45% better price/performance than the DEC MicroVAX II computer.

\* VMS operating system, DBMS database management system, Common Data Dictionary dictionary, Datatrieve inquiry facility, and TDMS forms management.

Note: The performance data presented in this document apply to this benchmark only. It is the user's responsibility to determine relevance to a specific application.