Honeywell report on Operating Systems

What's an operating system? What can it do? How much will it cost? Why should you use one? Today, "operating systems" — the generic term applied to software packages aimed at improving computer operating effectiveness — are a key topic of interest among users of data processing equipment. Operating systems, in one form or another, have been in use over the past decade. However, today's new generation of computer performance has done much to highlight the significant role an operating system can play in harnessing the full potential of a new generation data processing system.
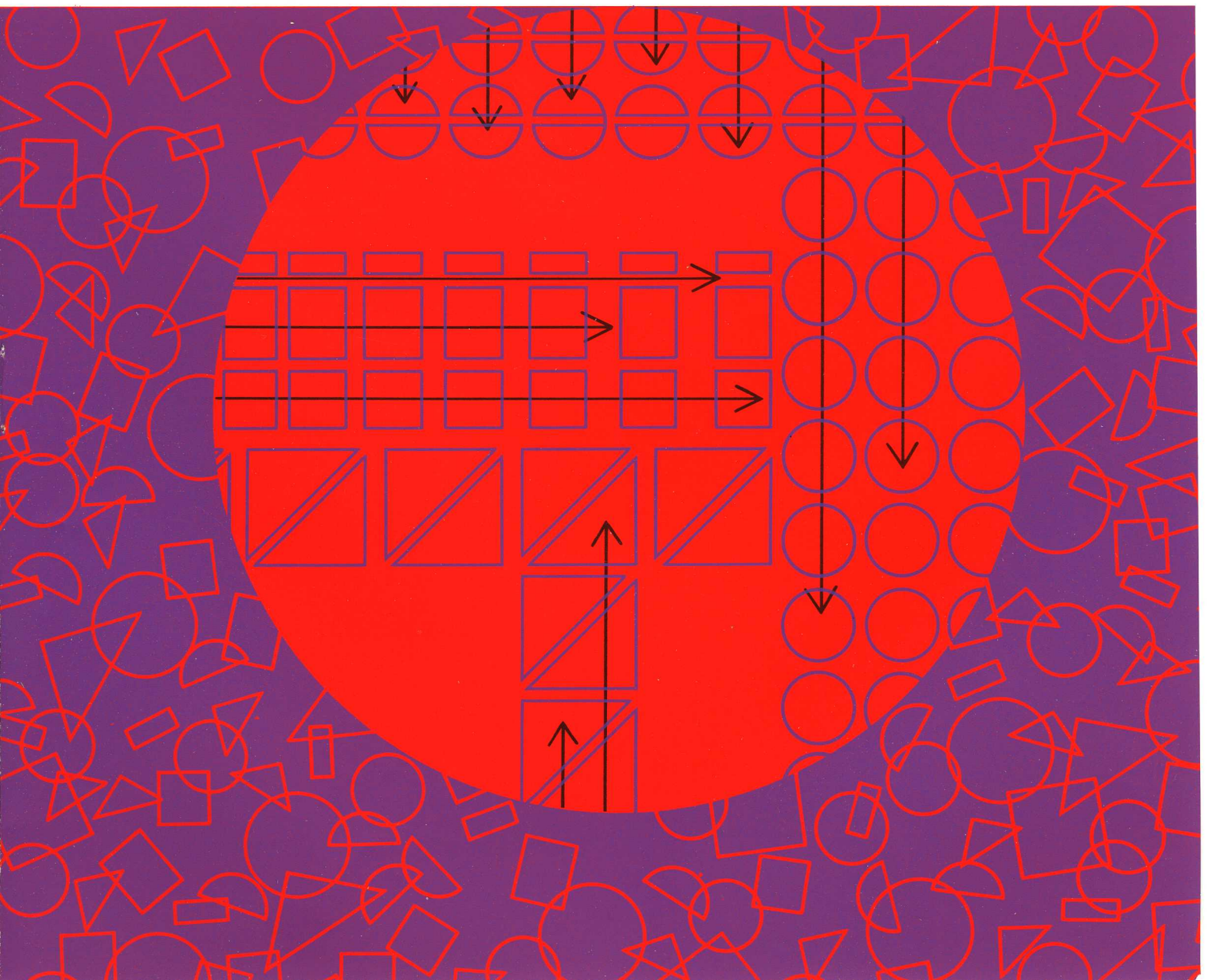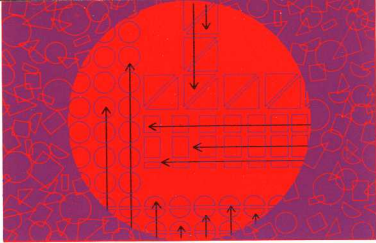
New generation computers, such as Honeywell's Series 200, have the potential to do more work in less time; to perform individual operations faster, to perform multiple operations at the same time. Yet even the most casual observer will quickly realize that a new computer, by itself, is no guarantee of increased data processing efficiency. Thus the interest in operating systems — those impressive, if not mysterious, software packages that appear to "guarantee full computer performance when used as directed." This report describes Honeywell's progress in the development of operating systems, illustrates important design concepts, and offers several criteria for determining how successful an operating system will be in meeting your particular operating needs.

WHAT IS AN OPERATING SYSTEM?

An operating system can be viewed as a framework within which all of the user's data processing jobs can be scheduled and performed. More specifically, an operating system is a comprehensive set of language processing and service programs executed under the supervision and coordination of an integrated group of control routines.

From a management standpoint, however, the value of an operating system should be measured not in terms of what it is, but rather in terms of what it can do. The following list indicates how major data processing objectives can benefit from the use of an operating system.

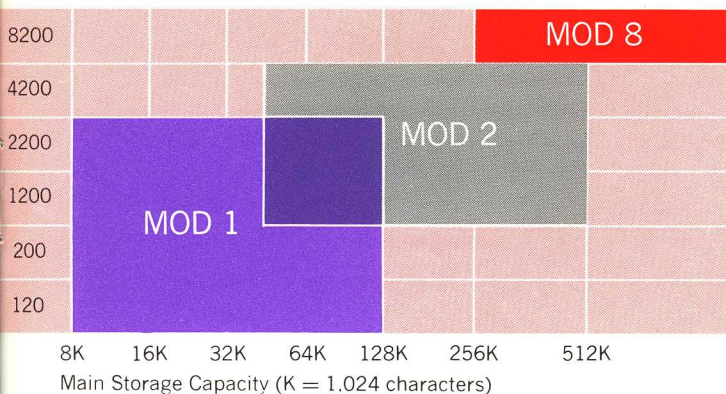| Objective	Operating System Benefits
1 Minimize turnaround time — the interval between submittal of a job for processing and return of processed results.	All required operations receive maximum automation; the extent of human participation is limited and controlled. Delays are eliminated through automatic processing of jobs from beginning to end on a single system.
2 Maximize throughput — the total amount of work which the system can perform in a given period of time.	All available system resources are effectively allocated. Idle system time and job setup time are reduced to an absolute minimum. Job-to-job transition is handled automatically.
3 Provide flexible and orderly growth potential.	Standards imposed by the operating system assure orderly expansion of functions and program compatibility. The user's programs and data files can be consolidated into a unified system together with manufacturer-supplied utility programs.
4 Make optimum use of computer memory and peripheral devices.	Through multiprogramming, an operating system can use central processor memory and peripheral units to maximum advantage. Programs can be device independent, giving great freedom in selection of input/output media.

DIFFERENT DESIGNS FOR DIFFERENT NEEDS

The functions that can be performed by an operating system range from relatively simple clerical tasks to highly complex operations such as dynamic allocation and control of system resources for multiprogram operation. In fact, a listing of all the functions which could be performed by an operating system would include dozens of entries. Yet extensive as it might be, such a list could not indicate how efficient a particular operating system would be in performing these functions.

In order for an operating system to do an effective job in meeting your operating requirements, it must be designed to be most efficient in those activities performed by your computer most of the time. This means that the basic design of an operating system is an important consideration because efficiency can come only by design, not by accident.

Realizing that one operating system design is not sufficient for handling the wide range of functions required by the users of Series 200 computers, Honeywell has developed an operating system which is divided into three models. This division reflects the fact that the operating requirements of a small-scale computer, such as Honeywell's Model 120, are better handled by an operating system with a basic design that is attuned to these requirements than by one designed to fit the requirements of a large-scale Model 4200.

Each model is designed to fit a specific range of core memory and system environment features. Furthermore, each model offers unique capabilities which reflect the needs of users at various levels of system development. For example, a major and important difference between Mod 1 and Mod 2 lies in the control of input/output functions. Mod 1, designed primarily for the smaller user, reduces equipment overhead to a minimum by decentralizing input/output control functions. Mod 2, designed to achieve maximum throughput efficiency, uses centralized control to permit greater flexibility in the larger equipment configuration. The following table shows the relationship between the models of the operating system and the various Series 200 computers.

8200				MOD 8		
4200			MOD 2			
2200	MOD 1					
1200						
200						
120						
	8K	16K	32K	64K	128K	256K	512K

Main Storage Capacity (K = 1,024 characters)

HARDWARE DESIGN AFFECTS ROLE OF OPERATING SYSTEM

In order for a computer to solve a user's problems it must first be able to solve its own problems. The computer's problems involve knowing what to do next and how to go about doing it. In computers, such as the members of Honeywell's Series 200, which can perform several input/output operations concurrent with computation, the magnitude of the computer's own problems is significant. Thus the way in which the computer solves its own problems is significant too.

An important design feature of every member of Series 200 is the ability to control all simultaneous input, output, and computational activities via automatic, built-in hardware. By building all basic control functions into the hardware, the following significant advantages are realized:

1 The computer, large or small, in no way depends on an operating system as the basic form of system control. This eliminates the undesirable situation of having a potentially large memory overhead for the purpose of enabling the computer to solve its own problems.

2 With all basic control functions handled by automatic hardware, the operating system can devote its full attention to the area of greatest importance to the user: the efficient application of the computer's resources to the solution of the user's problems.

3 The overhead imposed by the operating system can be held to an absolute minimum, since it performs only those functions required by the user, not by the computer itself.

HOW MUCH DOES AN OPERATING SYSTEM COST?

On the surface, operating systems appear to be free of charge. The computer manufacturer can supply one at no extra cost to the user. However, in actual operation, an operating system can be quite costly in terms of the equipment it uses and the time it takes to perform its functions. Here again, the basic design of the operating system and its ability to fit the user's requirements play an important role.

In order for the computer user to tolerate the overhead imposed by an operating system, it is imperative that the overhead yield significant advantages which could not otherwise be attained. In the case of a Honeywell Model 4200 user, for example, an operating system overhead of 32,000 characters out of a total memory of 262,000 characters is tolerable if such a trade-off enhances the responsiveness of his on-line real-time management information system. On the other hand, a Model 200 user applying the same operating system to his simple stacked job processing operations, may find the memory overhead to be intolerable because the level of performance offered by the operating system does not justify the cost of the memory overhead.

Honeywell has made it possible for the smaller user to avoid a major operating system overhead by offering an operating system model especially designed to fit his requirements. The following table lists the equipment necessary for the various operating system models as an indication of what it really costs to use them.

Operating System Model	Minimum Memory Overhead (K = 1,024)	Input/Output Requirements For Program Execution
MOD 1	1.4K char.	1 card reader or 1 magnetic tape or 1 mass storage unit
MOD 2	17.5K char.	3 magnetic tapes 1 console
MOD 8	64K char.	1 mass storage unit
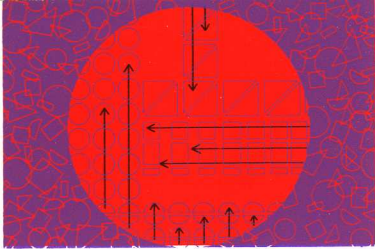
THREE GENERATIONS OF OPERATING SYSTEM EXPERIENCE

The following timetable of developments highlights Honeywell's role as a major innovator in the design and production of operating systems.

1957 Honeywell creates its first operating system for the D-1000 computer. Containing a monitor program and extensive program testing facilities, it was the first operating system of its kind to employ file updating techniques for program checkout operations.

1960 Honeywell releases the Executive System, the industry's first multiprogram operating system. Developed to fully automate the simultaneous execution of up to seven programs, the Executive System provided several important features for job scheduling, equipment allocation and supervision of program execution.

1963 The operating system concept is expanded significantly by the introduction of the Admiral operating system. Offering a dynamic scheduling facility, Admiral enables the user to stack job requests in a queue and obtain automatic processing with optimal utilization of all system components.

Today Models of the Series 200 operating system compress all of the necessary and desirable features for automated multiprogramming operations into the smallest possible amount of core memory. The Series 200 operating system is modular in design, enabling it to control a wide range of operating environments; including real-time, data communication, and random access file processing.

The experience gained from the development of three generations of operating systems has enabled Honeywell to offer users at all levels a full complement of automatic operating functions with truly minimal equipment requirements.

HOW TO GET TO A HONEYWELL OPERATING SYSTEM

Honeywell's unique Liberator concept makes it possible for users of IBM 1400 series equipment to automatically translate existing program libraries into Series 200 programs which operate under operating system control. Specifically, 1401, 1440, and 1460 programs can be translated into Series 200 programs which operate under control of Mod 1. Programs written for the 1410 can be translated to operate under control of Mod 2. In addition, users of small scale Series 200 computers in moving up to large equipment can take advantage of the extensive capabilities of Mod 2 without major reprogramming.

CHECKLIST FOR EVALUATING AN OPERATING SYSTEM

The tremendous disparity in operating speeds between computer hardware and its user magnifies the importance of allowing the computer to control itself, by itself, with the aid of an operating system. The following checklist summarizes the major points to consider when evaluating operating systems.

● Check the functions performed by the operating system. How many of *your* operating requirements does it meet?

● Check *all* equipment requirements. How much memory does the operating system require? How many peripheral devices must be reserved for use by the operating system?

● Check the experiences of current users. Find out how the operating system has helped them.

● Determine to what extent reprogramming will be required to enable existing programs to fit into memory left after insertion of the resident portion of an operating system.

● Determine what additional expenditure will be required to provide hardware necessary to move up to a more comprehensive operating system.

WRITE FOR MORE INFORMATION ON SERIES 200 OPERATING SYSTEM CAPABILITIES

For more detailed information on how major data processing objectives can be attained with the aid of an operating system, send for the publication listed in the coupon.

Honeywell
ELECTRONIC DATA PROCESSING