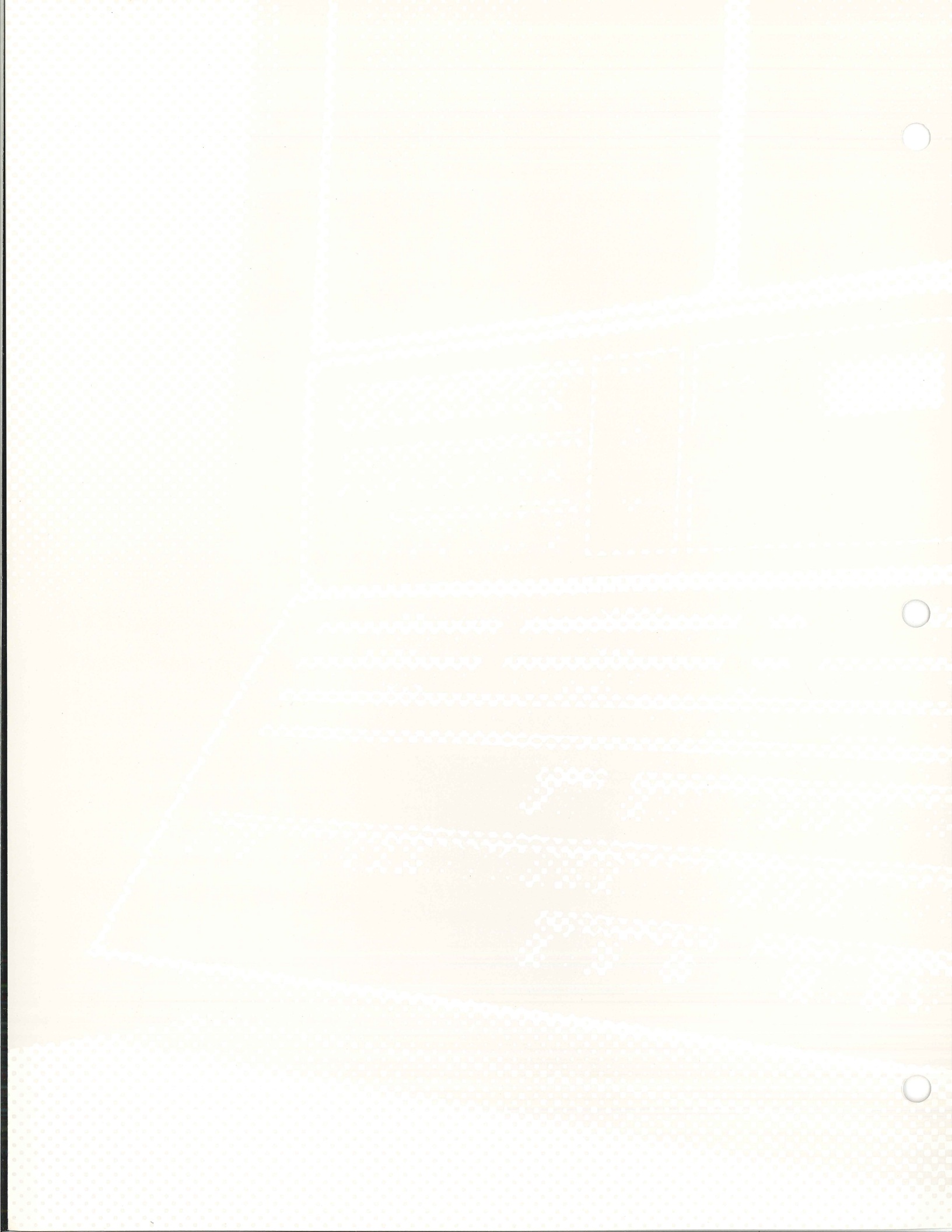


DECsystem-10 in INDUSTRY

digital



DECsystem-10 is a family of large-scale, multifunction computers utilizing a single operating system and command language. Equally suited to service real-time tasks, batch processing and interactive computing, each member of the family offers unmatched price/performance value, provides unparalleled reliability and flexibility of operation, and is uniquely simple to use and expand.

Versatility of application also is a family characteristic. Over 200 systems are now in operation, many in industrial establishments, where the applications range from managing computer networks (some of which contain dozens of computers) to testing the engines and fuselage of supersonic aircraft. A similar variety exists among DECsystem-10 users. Not only are they found in nearly every major industry, they vary in size from hundred million dollar corporations to Fortune's top ten.

COMPUTER BOTTLENECKS AND WHAT TO DO ABOUT THEM

Sometimes computers don't live up to expectation. They get bogged down in scheduling and end up being bottlenecks for managers, engineers and even the EDP staff.

Batch jobs backlog. Punched cards pile up. Nerves fray. Reports arrive late and decisions get made on the basis of stale information.

Computer-based quality control goes to pot. Potentially defective parts get out the door before they're caught. Customers complain and start looking to the competition.

Engineers grumble about waiting days or weeks for design calculations or verification of new concepts. Due dates slip and enthusiasm wanes.

But. Enter DECsystem-10 with its multifunction capabilities and high-volume throughput. Exit bottlenecks.

Connecting its interactive terminals to manufacturing, engineering and accounting does away with most punched cards. Through the terminal, managers can have every operation at their fingertips. Reports take less time to process and are instantly available.

Engineers can interact with their work on the spot. Calculations take only moments, eliminating delays and dampened enthusiasm.

Quality control personnel can be on top of problems before they become problems, saving time, materials and customers.

DECsystem-10 can also run batch jobs just the way they're run now, except that it can handle many jobs simultaneously through its multiprogramming capability, even while managers and engineers are using the interactive terminals.

Moreover, DECsystem-10 can control an entire manufacturing operation, host a network of computers, and support program development, all without interfering with on-going batch and interactive operations.

And if more than one plant requires the services of a major computer, our remote systems capability enables full use of DECsystem-10 through ordinary communications links, as though DECsystem-10 were right next door instead of tens or hundreds of miles away.

And DECsystem-10 can do away with system software headaches because it comes complete with software proven in over 200 installations. And since it's backed by expert system engineering and programming talent, users can do without an extensive supporting staff.

SPECIFICALLY, WHAT CAN DECsystem-10 DO?

Through its multifunction capability, DECsystem-10 can handle *all* computing requirements, tomorrow's as well as today's.

Briefly, it can:

Upgrade quality control programs, eliminating costly paperwork delays and product waste.

Determine the profitability of any customer or order immediately.

Manage production, inventory and distribution operations more efficiently.

Optimize the day-to-day scheduling of workforce and facilities.

Provide real-time interaction between manufacturing operations, production management and workforce.

Maintain a common real-time data base for engineering, manufacturing and accounting.

Replace punched card data entry procedures, personnel and equipment with interactive display terminals.

Service remote users as effectively as on-site users.

Expand to match growing needs without obsoleting hardware or requiring major changes in software or operating procedures.

DEC'S INDUSTRIAL EXPERIENCE

DEC has been manufacturing digital products for industry since 1957. Immodestly we admit to having sold more minicomputers for controlling machines, instruments, processes and manufacturing operations than all of our competitors combined. What's more, our lines of industrial logic modules are the world's broadest. And as the following descriptions indicate, DECsystem-10 computers are well established in such activities as pipeline management, aircraft design and testing, plant and production management in the metal-working industries, and automobile parts manufacturing. In fact, DECsystem-10 occupies a key position in some exceedingly sophisticated and demanding operations.

PIPELINE MANAGEMENT AND CONTROL

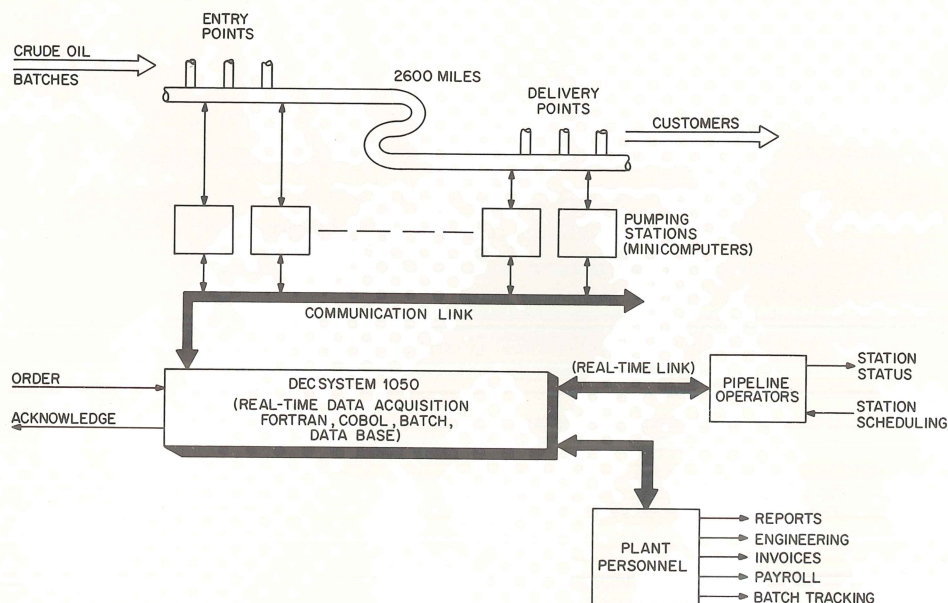
Oil Pipeline Distributor

DECsystem-10 and a network of 44 remote satellite computers are being used to manage and control a major oil pipeline distribution system. Located at pumping stations along the pipeline, the satellite computers communicate with the host DECsystem-10 at headquarters over a leased, voice-grade telephone line.

The satellite computers monitor each pumping station and report changes in status to the host computer. They also control the pumping stations in response to information received from the host computer, but are able to take independent action if alarm conditions arise.

The host DECsystem-10 continuously accepts, validates and stores operating data from the satellites. It also operates special control consoles at the central installation, maintains inventory information on all of the various batches in the pipe, routes each batch to the right customer, and adjusts the operation of the pumping stations so as to minimize power consumption, the principal operating expense of the pipeline. In addition to these on-line functions, DECsystem-10 handles engineering studies and normal business data processing.

Since installation of the computer network, many of the pumping stations are able to operate unattended, power consumption has been reduced, and product tracking and routing have improved.



PRODUCTION CONTROL AND MAINTENANCE OPTIMIZATION

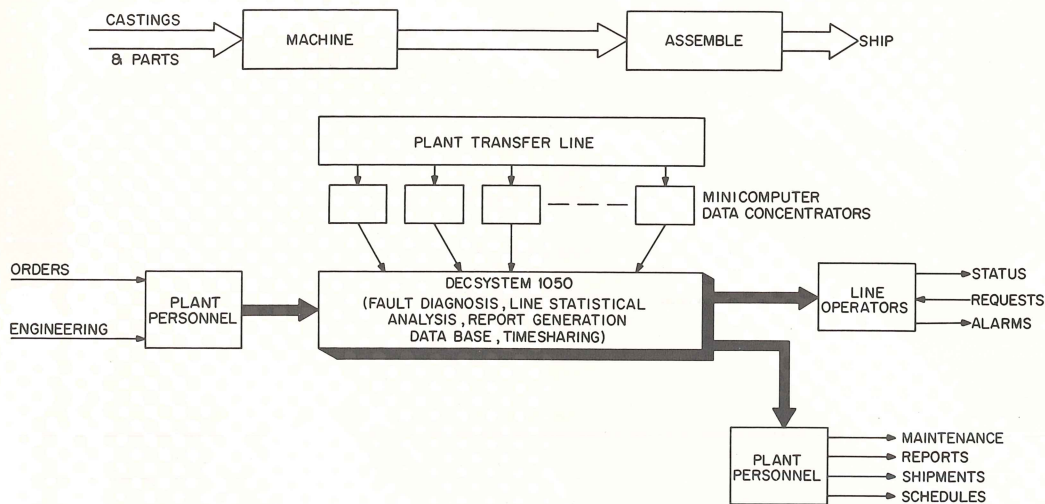
Parts Manufacturing

One of the world's largest manufacturers uses DECsystem-10 to run a plant-wide computer network. Over 200 machine tools and assembly devices involving more than 40,000 control functions are being monitored by the network's satellite computers.

The system has two primary functions: maintenance optimization and production control. Several times per second, DECsystem-10 checks the power, oil pressure, temperature and other critical conditions of each machine tool and assembly device in order to determine whether or not it is operating properly. If an out of limits condition is detected, the computer runs a diagnostic test to identify and locate the probable cause of the failure. When the cause has been located, DECsystem-10 notifies the maintenance supervisor of the failure, its probable cause, and the parts which may be required to restore proper operation. Maintenance personnel are able to respond promptly, repairing failures in a minimum time.

DECsystem-10 periodically runs a complete check on each of the machines and assembly devices and compares the results with the expected results and the recent history of each machine or device. Potential maintenance problems can thus be found and remedied before they cause equipment or tool-change downtime.

In addition, DECsystem-10 helps to direct material flow in the plant. If a machine stops, production personnel at inplant terminals can quickly redirect material flow to minimize the effect of a specific stoppage on overall plant operation. DECsystem-10 also keeps track of raw material and finished goods inventories, supports development of new application programs, and handles data processing tasks and management reports.



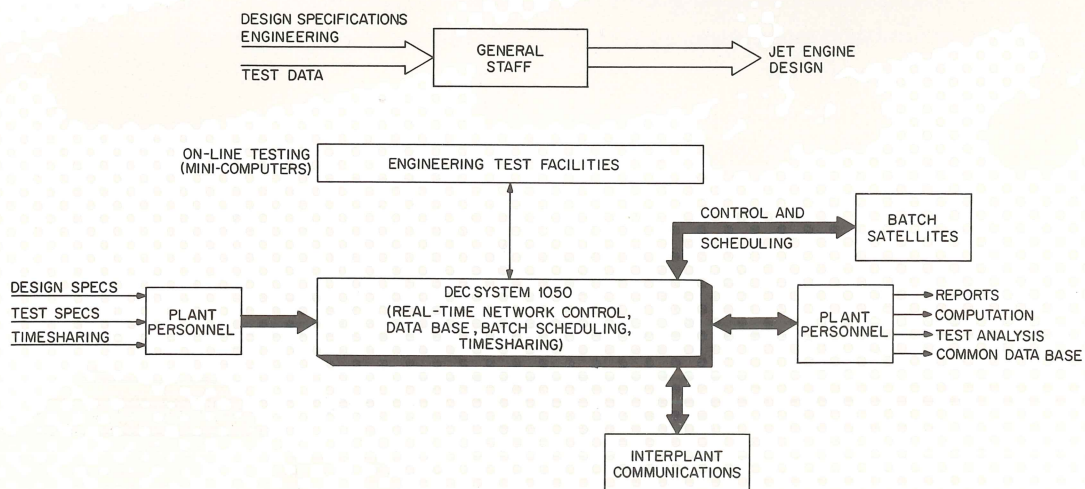
DESIGN, ENGINEERING AND TESTING NETWORK

Jet Aircraft Engines

A manufacturer of jet aircraft engines is using DECsystem-10 to control a network comprised of two local large-scale batch processing computers, one remote batch processing computer, and ten satellite minicomputers. As a network controller, the primary task of DECsystem-10 is to provide interactive computing services for design and development engineers via any of 50 terminals currently connected to the system. Among these services are the development of engine performance profiles, preparation of preliminary performance and test specifications, and the analysis of engine test data.

DECsystem-10 also maintains a common base of current test data for use by the entire engineering staff and optimizes the batch processing operations of the two large-scale computers by scheduling their jobs and controlling their outputs. The extremely large, complex programs typical of jet engine development are run on these two computers and at the remote batch processing center. In addition, the engineering and test programs for these computers are developed on DECsystem-10 through its interactive terminals.

Tasks handled by the satellite minicomputers under the direction of DECsystem-10 include the automatic acquisition of engine performance and vibration data, the preprocessing of NC tapes for machine tools, and the control of peripherals such as line printers and card equipment.



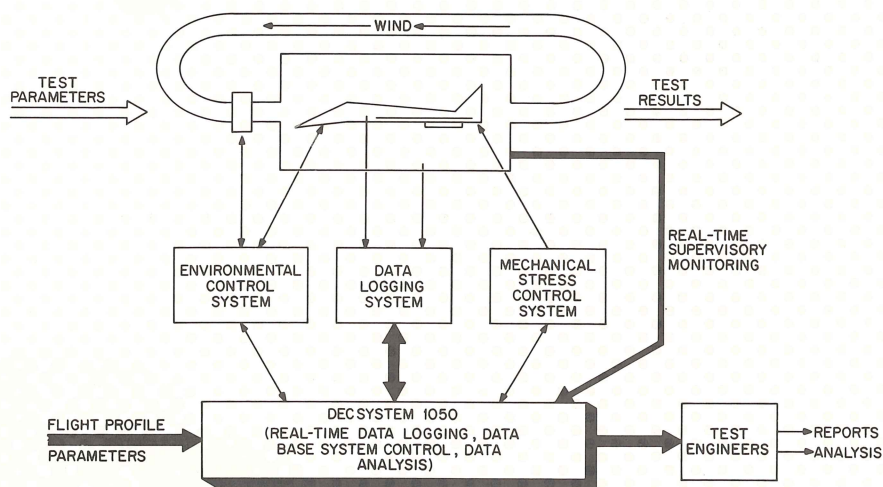
ENGINEERING, SIMULATION AND TESTING NETWORK

Airframe Testing of Supersonic Aircraft

A manufacturer of supersonic aircraft is using DECsystem-10 and a network of satellite computers to test full-size airframes of supersonic aircraft in an elaborate, specially designed test facility. The facility includes a sheath-like wind tunnel, environmental control equipment, and a combination of hydraulic and electronic devices for applying complex mechanical and thermal stresses to the airframes under test. By means of this facility, engineers are able to simulate the conditions of flight operation over a prolonged period, and to simulate extreme operating conditions too difficult to test in actual flight.

Flight profiles are specified by test engineers on one of the interactive terminals of DECsystem-10. DECsystem-10 then translates each profile into settings for the various environmental and mechanical controls. Two satellite computers do the actual controlling, with DECsystem-10 continuously monitoring the tests and updating the control settings.

During a test, a third satellite computer continuously collects data through an array of over 3700 sensors in the test facility and airframe and transmits it to DECsystem-10 for storage. DECsystem-10 performs a real-time check of this data in order to identify potential failures before they occur. This allows design engineers to stop a test temporarily while the test data is analyzed. Upon completion of a test sequence, which could run from several minutes to several days, the accumulated data is analyzed with DECsystem-10 using interactive terminals and a graphic display terminal interfaced to the system.

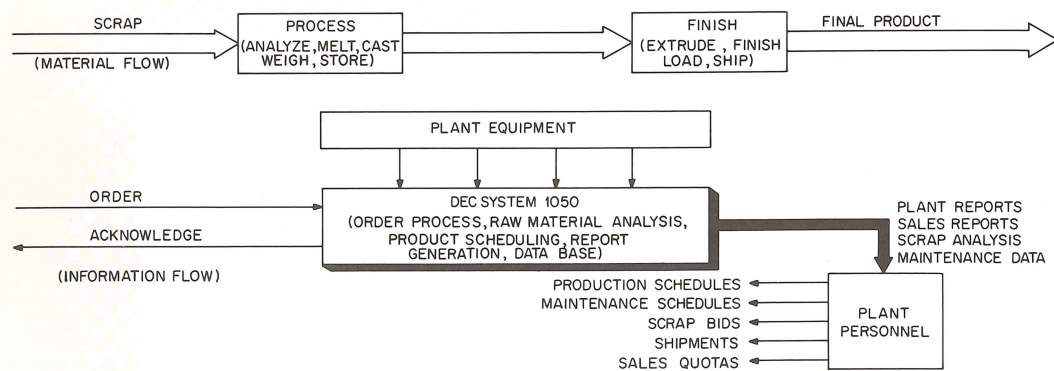


MANAGEMENT INFORMATION AND PRODUCTION CONTROL SYSTEM

Brass Rod Production

A major brass company is using DECsystem-10 to provide complete information services for management and to support all production planning functions and manufacturing operations. With DECsystem-10 the manufacturer has been able to coordinate all departmental activities, enabling significant improvements in customer service, in scheduling both people and production, in optimizing raw material procurement and product distribution, in handling routine business data processing, and in minimizing maintenance.

In its production support role, DECsystem-10 is interfaced directly with the manufacturing operation, gathering and analyzing data from weighing stations, counters, furnaces, casting and machining operations, and raw material samples. On demand from any of the fourteen interactive terminals in the plant, management can obtain production figures by shift or day for any interval up to a year. Managers can also request immediate reports on sales activity, customer profitability, quality control, inventories, shipments, backlogs, production costs, maintenance requirements, and personnel utilization. DECsystem-10 is attended by two operators during the day shift and runs completely unattended for the remaining two shifts, providing reliable operation 24 hours a day, 5 days a week.



MULTIFUNCTION CAPABILITY

As the preceding actual applications show, DECsystem-10 does indeed offer true multifunction capabilities...

- Real-time data acquisition and control
- Local and remote batch processing
- Computer network supervision
- Interactive timesharing

And the reason DECsystem-10 is able to handle such a variety of job types and response requirements is its unique operating system and advanced processing hardware. Many important features of this operating system and hardware are presented in the next several sections, along with concise descriptions of each major function. Principal among the features are adaptive scheduling, file handling multiprogramming and swapping, and the languages available.

OPERATING SYSTEM

Adaptive Scheduling

The DECSYSTEM-10 operating system maximizes throughput by using an adaptive scheduling algorithm to schedule system resources. It assigns resources based on the dynamic state of each program. This keeps response time to a minimum for highly interactive jobs and reduces swapping for jobs which require heavy processor use.

All input/output operations and scheduling are automatically performed for the user by the operating system. In addition, it optimizes disk or drum access by queueing requests in least time-to-go order. Although the operating system supplies the user with a broad range of services, it accomplishes its tasks with exceptionally low overhead. Moreover, it never requires the user to preallocate file storage but dynamically provides storage space on demand. This feature is not only convenient for the user, it prevents large blocks of storage from being tied up unnecessarily.

File Handling

File service for disk packs and drums is designed for maximum convenience and efficiency. Each user may have as many files as he desires on any of the file storage devices in the system. The only limit on file size is a quota, which the installation can set for each user, or the physical capacity of the installation-defined file structure, which can include storage on several similar devices. Each file is referred to by name so that the user is not required to know where his file is physically located.

For user convenience, file organization is independent of access method. Therefore it is not necessary to reorganize a file completely to change from sequential access to random access methods. The user may even change his access methods during file processing.

Multiprogramming / Swapping

To keep a number of user programs running concurrently, the operating system uses multiprogramming and swapping. However, if memory demand exceeds the supply, the operating system will automatically bring higher priority programs from disk or drum into memory, swapping them with lower priority jobs.

Because each memory block operates independently, the processor can be executing a program in one memory block while programs are being swapped in another. Since the system does not require fixed partitions, a program that has been swapped out does not have to be swapped into its former location to continue execution.

The monitor saves core through reentrant software. Only one copy of a language processor (or any systems program larger than 1K) need be core-resident to serve multiple users simultaneously.

Languages

COBOL, FORTRAN, ALGOL, BASIC and MACRO (assembler) are available in standard operating systems. In addition, large numbers of user-developed programs and simulators are available through the Digital Equipment Computer Users Society (DECUS).

REAL-TIME OPERATION

DECsystem-10 provides a complete range of services designed to meet the requirements of real-time users. These services are implemented through special instructions in each real-time program or by console command. This enables the user to:

- Start the execution of a program at a specified time.
- Start the execution of a program upon occurrence of an external event such as an alarm condition.
- Start the execution of a program upon request from another program.
- Run a program on a periodic basis under control of the system clock.
- Suspend the execution of a program until a specified event occurs or until a specified amount of time has elapsed.
- Start or stop any real-time device interfaced to the system.
- Read or write data in the data base.
- Change the priority of a real-time device, or disconnect it from the priority interrupt system.
- Specify the priority of real-time programs relative to any other programs running on the system.

The real-time user also has a choice of response times. When an extremely fast response is desired, a program may be run in the executive mode, directly in response to device interrupts.

Normal real-time operation is achieved through real-time instructions which provide typical response times of 100 microseconds or less.

Programs requiring response times of a few milliseconds are scheduled in any one of 15 real-time queues maintained by the operating system.

A very important feature of DECsystem-10 is the multi-partitioning hardware facility which protects the system against errors in a real-time program and also protects all programs from each other.

MULTIPROGRAM BATCH OPERATION

The multiprogram batch capability of the operating system provides wide flexibility for both the real-time user and the computer system operator. A number of batch jobs can be run in the background concurrently with real-time data acquisition. Batch users can enter their programs through equipment at the central computer site or from remote batch stations, and they can use interactive terminals to analyze data being accumulated in real-time.

To optimize batch throughput, the operating system dynamically schedules system resources among user programs. The system can be entirely dedicated to batch operations or the computer system manager can specify the percentages of processing time and core memory that are to be dedicated to batch processing and real-time functions. The scheduling is achieved in such a way that no interference occurs between functions, regardless of function or load.

The batch command language also allows wide latitudes for the experienced user. For example, the user has a choice of submitting his job via card reader, magnetic tape, or disk packs, in a variety of input modes. He can also set "start" and "complete" time limits for program execution, giving a DO NOT START BEFORE date and time, or the date and time by which a program must be completed.

If order of execution is important, the user can state, for example, that programs A and B cannot be started until program C has been executed. He can also request that a particular program be executed at specified intervals.

The user can also control system response to error conditions. For instance, if his program should contain an error, he can specify the emergency action to be taken, such as skip to the next program, or transfer to a special error handling routine. To stop looping, he may set an execution time limit. He can also set limits on program output, such as the number of pages printed, number of cards punched, and so forth.

A user can also delete any of his jobs or change their parameters locally through his terminal or through a remote batch station.

REMOTE STATION NETWORKS

To meet the requirements of remote access to DECsystem-10, the system can support a variety of remote stations. Each station includes a minicomputer which serves as a controller for peripherals normally connected directly to the central processor. Through a standard communications link to the small computer, peripherals such as card readers, line printers, terminals, and A/D converters can be operated anywhere within phone communication distance of the central processor. To the users at these remote locations, the peripherals appear to function as though they were at the main site.

This capability not only brings the processing power of DECsystem-10 to remote locations, it makes possible a variety of system configurations. For example, the remote station is no longer restricted to batch processing; the station can simultaneously serve as a concentrator for up to 16 interactive terminals. And it can also be used for real-time operations, combining the advantages of a dedicated control computer with the power and flexibility of a large general purpose computer.

The real-time operation of the remote station can be as simple or as complex as the user desires. In the simplest case, the small computer can be used to acquire and store data. A DECsystem-10 program can later access the data for processing. In a more complex operation, the central computer can request periodic samples of process variables from the remote station, perform calculations with the data, and adjust the setpoints being maintained by the remote control system.

INTERACTIVE TIMESHARING

The DECsystem-10 interactive user can perform a wide variety of tasks from solving a simple mathematical formula to implementing a complete information gathering and processing network. Depending on the system configuration and load, the system can handle up to 127 interactive terminals simultaneously. Terminals may be keyboards, graphic displays or similar devices operating at speeds up to 200 characters per second.

DECsystem-10 has unique flexibility for interactive timesharing:

Real-time, batch and timesharing functions all utilize the same command language, so that the user need learn only one set of commands. And since the command language, file structure, input/output processing and job scheduling are independent of the programming language being used, the same program can operate in any one of the three modes—real-time, batch, or interactive—without any reprogramming. In addition, any interactive terminal can be used for remote entry of batch mode programs.

Through the simple command language, the user can exercise the following job control options at any interactive terminal:

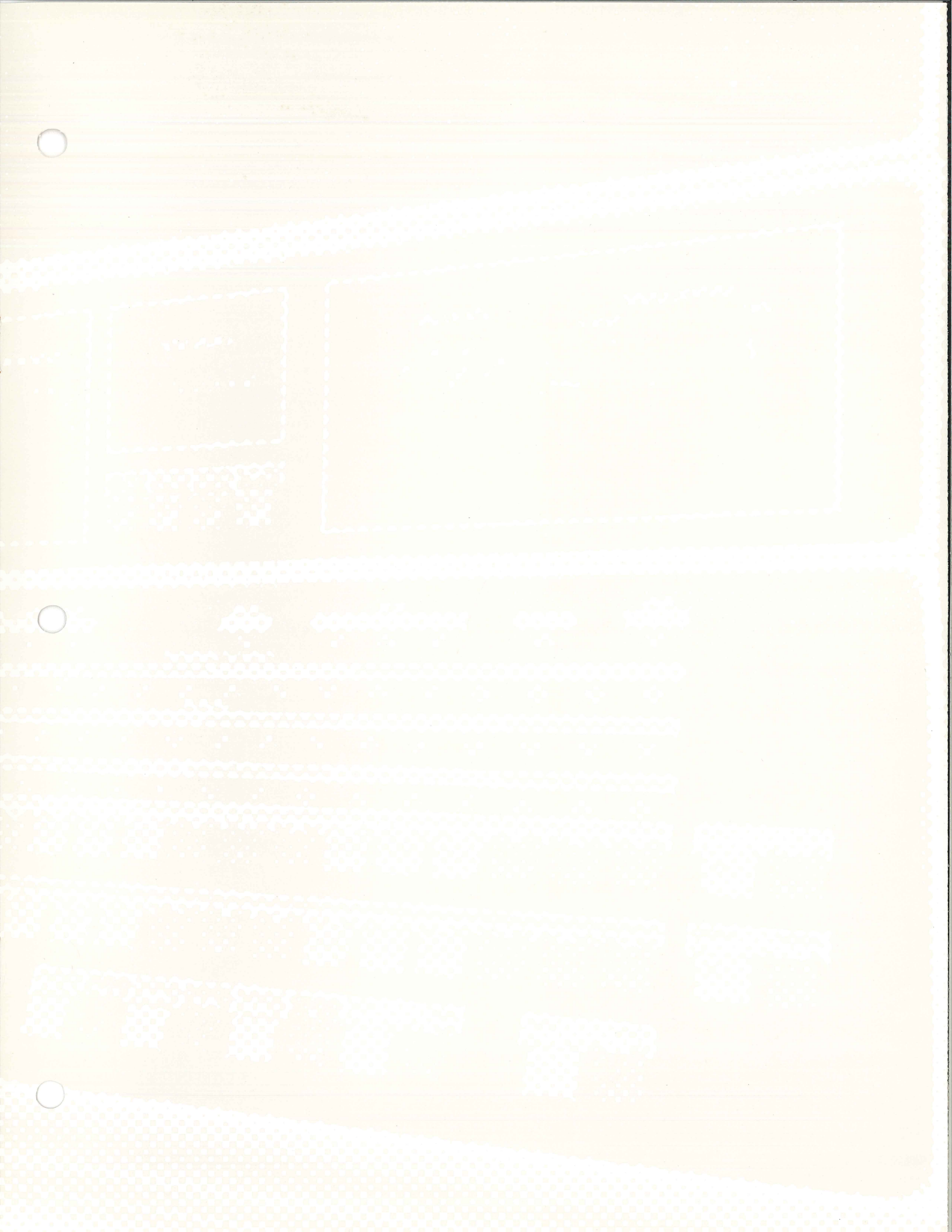
- Enter a program into the batch stream.
- Compile, execute, and debug programs.
- Create and edit files; list and delete files.
- Communicate with the system operator and request such services as the mounting and dismounting of disk packs, mounting of tapes, and copying of tapes on disk.
- Assign himself specific resources such as magtapes or private disk packs.
- Start, suspend, or terminate a job.
- Spool program output to a line printer, card punch, or like device.
- Determine status of the system and its resources.
- Request a time and resource accounting of his own use of the system.
- Send a message to any terminal in the system.

SALES, SERVICE, TRAINING AND SUPPORT

DEC's worldwide sales network includes over 100 sales and service offices in 11 countries. Teams of software and hardware specialists stand behind each account to insure a successful system and to lend assistance if needed for special programs or conversions. Our field service engineers not only supervise the acceptance and maintenance of DECsystem-10 but can be at any location within a few hours if a problem develops. Where required, system specialists can reside at customer sites on a full-time basis.

A complete training center with 42 full-time instructors provides comprehensive courses in programming, system operation and maintenance. During 1970, over 2,600 DEC customers attended training sessions at DEC facilities in Massachusetts, California, England, France and Germany.

Particularly valuable to DEC customers is the Digital Equipment Computer Users Society (DECUS), a voluntary nonprofit users group supported by DEC. With a membership of over 10,000, a European branch and numerous local chapters in the U.S., DECUS provides a lively interchange among members through meetings, seminars, technical publications and program exchange. Over 500 programs are available to members through the DECUS Program Library.



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Please send me the following literature:

- ____ DEC General Products Catalog
- ____ DECsystem-10 Benchmark Brochure
- ____ DECsystem-10 Technical Brochure
- ____ Industrial Application Notes
- ____ Real-Time Systems Brochure
- ____ DEC Annual Report 1972

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