APPLICATION SYSTEM OPERATION AND CONTROL

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I. Introduction.

Application System Operation and Control is the daily execution of, and supervision of, application system functions. It includes initiating programs that provide application functions to users and scheduling and monitoring background processes performing batch processing.

Until now, application system operation and control has required considerable user intervention. Also, since most buisness computing machines are general-purpose in nature, the task of initiating application programs is frequently left to personnel who are not computer professionals. Thus the user of an application (a clerk, receiving dock worker, etc.) may have to learn the host computer's command language and error codes, which are optimized for general machine use instead of individual applications.

Recent developments in operating system software have lessened the burden on the non-DP professional. These include user-defined commands, comprehensive "help" facilities, and so on. However, these have solved only a part of the problem. The user of an application should perceive the computer system as a comprehensive solution to an application problem and not as a set of unrelated application tools.

Hewlett Packard's Application Monitor (developed as a component of HP's Materials Management/3000) has made a significant contribution to the ease of control and operation of application systems. By controlling and supervising application system activities, the Application Monitor greatly reduces the system management time required of the system administrator. This allows more time for management of external functions in the environment where the applications are used.

II. Application Systems.

A. Traditional Activities.

Most application systems involve the following activities:

- o Initiation of on-line applications on user terminals.

- o Scheduling and monitoring of background job
  processing.

- o Initiating recovery and cleanup jobs.

- o Supervising system operation in order to maintain
  consistency in the application system environment.

Traditionally, most of these activities were executed
manually and required frequent human intervention. Control
of the application environment was totally dependant upon
the constant attention of the administrator or operator of
the system. This practice has led to inconsistent data
processing activities, sometimes resulting in the loss of
critical management reports or accidential data file
destruction.

B. User Interface.

User Interface is a very important area of application
system management. The easier it is for a user to utilize
the functions of an application system, the more productive
each user will be.

In many cases, when a user desires to execute a particular
application function, a program must be manually initiated
through the use of operating system command language
(whether it be an interactive process or background job).
This requires a knowledge of some command language syntax
and the capability to interpret the host computer's error
codes (which may be difficult for the non computer
professional).

The development of user-defined commands and comprehensive
"help" facilities have certainly improved the user
interface to application systems, but much more can be
accomplished to ease the burden on the non-DP professional.

II. HP's Recent Approach to Application System Management on the HP3000.

A. The Application Monitor.

The Application Monitor was developed as a component of HP's Materials Management/3000 product. It is an integral part of an application system. The monitor controls the execution of, and provides services to, applications running under its control. It schedules, initiates and controls all interactive and batch job activities in an application system. The monitor takes a major step towards operatorless, abortless, application systems by providing automatic application scheduling, control, and recovery services.

B. Classes of Users.

Two main classes of users make use of the services provided by the monitor:

o System Administrators

o End users

The system administrator is an individual who has global responsibility for the application system. This individual supervises all application system activities (i.e., background job scheduling, on-line application scheduling and control, etc.).

The end users of an application include all those who use application programs functions (i.e., clerks, managers, receiving dock personnel, stores or inventory personnel, etc.). End users benefit from good application system management, which leads to consistent data processing, reports that are on time, and other benefits. However, they do not usually get involved in actual operation and control.

C. User Interface

The user interface utilized by the Application Monitor is a friendly fill-in-the-form CRT interface. This allows the user or manager of the system to perform comprehensive system control without having to learn a complex command language. Each screen presented utilizes the CRT terminal's function keys. The functions are

described in eight shaded boxes at the top of the screen. Each box corresponds to a single function key (the leftmost box corresponding to function key 1 and so on.).

A command window is also presented on monitor menu selection screens. This area is utilized for special system control functions that may not be executed by a simple function key signal.

Sample user interface screens will be presented as part of this discussion.

D. Environment Definition.

The application system environment is defined through the use of the Application Customizer (also a component of Materials Management/3000). The customizer allows the user to define the following information for system operation:

o Terminal configuration

o Device configuration

o Schedule of when interactive applications are to run and their associated CRT terminals.

o Schedule of when batch jobs are to be initiated.

This information is stored in the customizer's application data dictionary for later user by the monitor. When the data in the dictionary is to be applied to the current application system environment, a process is executed that will copy this information into a "prepared" run time version of the dictionary.

The customizer's data dictionary contains other information which is application subsystem dependent (i.e., data item definitions, screen formats, data base formats, etc.) and will not be discussed in this paper.

E. Application System Operation.

The Monitor is composed of eight seperate programs. These programs run simultaneously and work together to monitor and control the application system (Figure 1 depicts the application system environment.).

```
        -----------------------------------
        | Host Computer Operating System |
        -----------------------------------
                         |
              -------------------------------
              |  Monitor Control Process    |
              -------------------------------
                         |
                  ---------------------------
              |                           |
              |       ------------------------------------------
              |       | Interactive Application Programs |
              |       ------------------------------------------
              |
              |
Monitor Services |
--------------------------------------------------------------------
|  SIP  |  SAI  |  SMP  |  SAP  |  PSM  |  JSP  |  BJP  |
--------------------------------------------------------------------
```
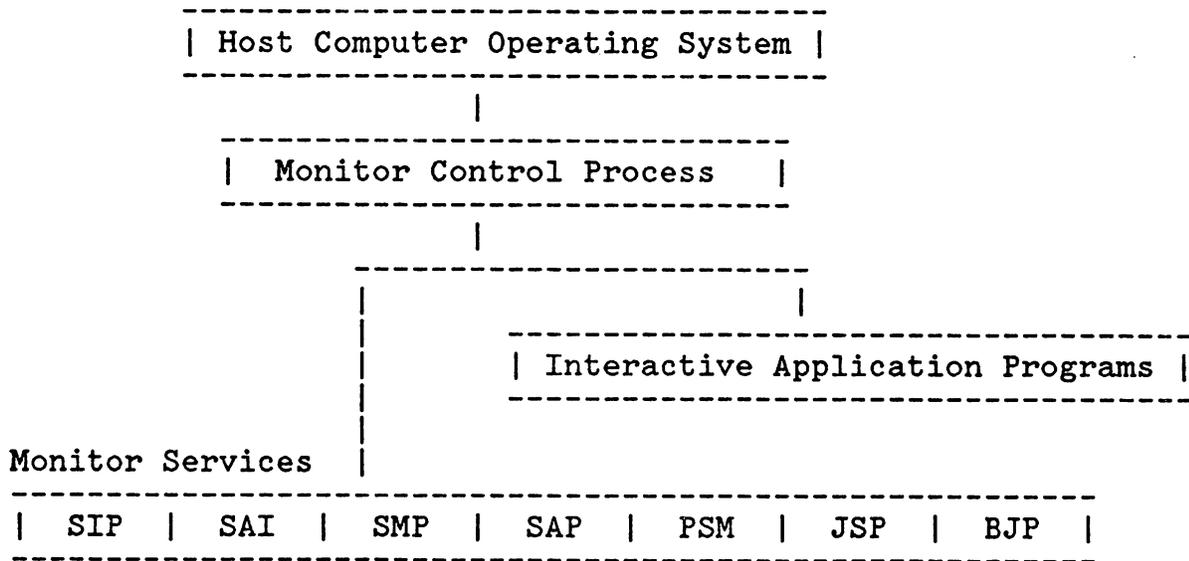
Figure 1. Application System Environment.

The application system environment, showing the
relationship of the Application Monitor to other programs.
The Application Monitor initiates, monitors, and controls
run time application activities. Monitor services are
provided to application programs and users to initiate
additional processes and supervise system activity.

The following is a brief description of the major processes that make up the Application Monitor.

Monitor Control Process (MCP)

The Monitor Control Process is the parent of all programs in the application system environment. Once the application system is active, it is this program which initiates, monitors and controls application program activities.

The MCP utilizes a memory table to track program activity throughout the system. This table is called the Application Control Table (ACT). Each program in the system has an entry in the ACT called a Process Information Block (PIB). The information kept in each PIB is sufficient for the MCP to monitor current status of each program and provide any services that are determined necessary.

System Initialization Process (SIP)

The System Initialization Process is initiated at system startup time and executes once a day. This program reads a prepared application data dictionary generated by the Application Customizer. Based on the information read from this dictionary, the SIP initializes global tables to be used by the application system.

System Administrator Interface (SAI)

This program is the system administrator's "window" to the Application Monitor. The SAI allows the user to select various functions to review and control application system operation.

Figure 2 depicts the user interface for the System Administrator Process.

Job Scheduler Process (JSP)

The Job Scheduler Process automatically schedules background jobs that were specified to be run on the current day. These jobs are pre-defined by the system administrator through the customizer.

Background Job Processor (BJP)

A background job that has been scheduled for execution
will be processed by the Background Job Processor.
This program executes background job commands and
provides comprehensive job restart/recovery capability.
System Activity Process (SAP)

This program allows the system administrator to review
and control system activities. Through the SAP user
interface, the system administrator can review the
current activity of all interactive and background jobs
and control background job processing concurrency.

Figure 3 depicts the System Activity user interface.

| System Messages | Process Schedule | Show Activity | Special Services | | | Change ENDofDAY | Start Terminal | Stop Terminal |

System   Displays system messages and provides review/reply capability.
Messages

Process   Displays all of the jobs scheduled to be run today. Also
Schedule   provides add, change, delete capability to the schedule.

Show   Displays the current status of the system, showing all of the
Activity   active terminal users, and report jobs executing and waiting.

Special   Presents a menu of additional special services available to the
Services   System Administrator.

Change EOD   Allows end of day to be changed on selective or ALL terminals.

Start Terminal Allows selective or ALL terminals to be started.

Stop Terminal   Allows selective or ALL terminals to be stopped.

Figure 2. System Administrator Interface.

The System Administrator Interface is the administrator's "window" to the application system. The functions which may be initiated from this screen are represented in eight shaded boxes at the top of the screen. These functions are initiated by depressing one of eight CRT terminal function keys. The first shaded box corresponds to function key 1, the second to function key 2, and so on. This relieves the system administrator of the need to memorize a system command language, and allows functions to be initiated quickly and accurately.

| Show All | Report Jobs | Cancel a Job | Set Limits | | Suspend a Job | Next Page | List Offline | EXIT |

*Report jobs are preceded by an asterisk.

Terminal ID or Report Name	Terminal screen or Report step	Terminal Response		Rpt step elapsed minutes	Total trans /step#	Activated (Day,Time)	
		last trans	cumulative average				
BOB'S TERMINAL	REVIEW PART	4	3		10	MON	8:02AM
BARRY'S TERMINAL	ADD WORK ORDER	6	4		8	MON	8:00AM
MARTA'S TERMINAL	CHANGE PART	4	4		5	MON	8:05AM
HARRY'S TERMINAL	REVIEW ROUTING	2	1		4	MON	8:05AM
VINCE'S TERMINAL	ADD PURCH ORDER	4	3		20	MON	8:00AM
*DAILY REPORT	SORT INPUT			10	3	MON	7:50AM

Figure 3.   System Activity Process User Interface.

The System Activity Process allows the system administrator
to review current system activity. Interactive application
transactions may be tracked and background job execution
may be controlled. In this example, BOB'S TERMINAL is
executing the REVIEW PART transaction (ten transactions
have been executed, and the terminal has been active since
8:02 AM.). A backgound job (DAILY REPORT) is running and
is presently executing the SORT INPUT step.

Processing Schedule Maintenance (PSM)

The Processing Schedule Maintenance process allows the system administrator to review and modify the background job processing schedule for the current day.

Figures 4 and 5 depict the user interface for the Processing Schedule Maintenance process.

System Messages Process (SMP)

Messages informing the system administrator of the specifics of system activity may be reviewed with the System Messages Process. Certain messages may require a reply from the system administrator. The reply may be processed utilizing the SMP user interface.

Figure 6 depicts the user interface for the System Messages Process.

Show Schedule	Modify Schedule				Prev Page	Next Page	List Offline	EXIT

Job Name	Scheduled Run Day or Date	Run Time/ Shift	Auto Start	Job Description
SUMMARIZED BILL	DAILY	09:00 AM	N	SUMMARIZED BILL REPORT
WEEKLY INVENTORY	MONDAY	09:30 AM	Y	WEEKLY INVENTORY REPORT
PRINT MESSAGES	DAILY	11:59 PM	Y	OFFLINE DAILY MESSAGES REPORT
MONTHLY ACTIVITY	02	11:59 AM	Y	ACTIVITY REPORT (2ND DAY OF MO)

Figure 4.   Processing Schedule Maintenance User Interface

The Processing Schedule Maintenance process allows the system administrator to review the background job schedule for the current day. In this example, three jobs are scheduled to be run. The first job (SUMMARIZED BILL) has its AUTO START flag set to "N". This means that it will require manual intervention to run. The administrator must set the flag to "Y" in order for the job to run. The other jobs will run automatically when their time comes up.

| Add A Job | Change A Job | Delete A Job | Find this job | | Show prev job | Show next job | Show First | EXIT |

Job Name	--Todays Run Time-- Time or Shift	Auto Start	Job Description for Today
PART REPORT	10:30 AM	Y	PART REPORT JOB

	Job Status	Current Checkpoint	Completion Code
	▆▆▆▆▆	▆	▆▆▆

Note: As long as this screen is displayed, no new report jobs will be
scheduled to run.

Figure 5.   Processing Schedule Maintenence User Interface.

   The system administrator may modify the current day's
   background job schedule through the use of the Processing
   Schedule Maintenance process. In this example, a job
   (PART REPORTS) is being added to the schedule. If this
   job is to be run at regular intervals, the system
   administrator may add it to the permanent job schedule in
   the application data dictionary via the customizer. The
   job will then automatically be scheduled to run daily,
   weekly, monthly, or yearly as specified.

```
Show all  Show all  Reply to    Last              Prev      Next      List
Messages  Action    Pending     Page              Page      Page      Offline    EXIT
```

```
 Time    Msg# Message (action or reply = *)
```

```
07:10 AM 001   Customization completed.
07:20 AM 002   Job CHECK DB CHAINS failed - initiating recovery.
07:21 AM 003   Job CHECK DB CHAINS failed - initiating recovery.
07:22 AM 004  *CHECK DB CHAINS restarted once and failed.  Retry?
```

Figure 6.   System Messages Process User Interface.

The System Messages Process allows review of system
informational messages and messages requring action from
the system administrator. In this example, a background
job has been restarted and failed on the restart. The
Background Job Processor is asking the system administrator
if the job should run again. The system administrator may
initiate the reply action to this messages by depressing
the appropriate CRT terminal function key which corresponds
to a shaded box at the top of the screen.

F. System Startup

The Monitor Control Process is the initial program to be run in the application system. The MCP is initiated via a user defined command supplied with the installation software. This relieves the user from having to know the physical file name of the MCP and any parameters that must be supplied.

The MCP launches the System Initialization Process. The SIP reads the prepared application data dictionary generated by the customizer. This dictionary contains information critical to system operation and control. Utilizing this information, the System Initialization Process builds global tables to be used during that day's operation of the system. When initialization is complete, the MCP begins normal execution.

Figure 7 depicts the application system environment during system start-up time.

G. Interactive Application Process Management

Application processes are launched according to values initialized in the ACT. When the MCP initiates an application program it sends the program its PIB entry number. This PIB entry number corresponds to a physical PIB in the ACT. By utilizing this number in Monitor supplied intrinsics, the application may perform the following functions:

- o Obtain information regarding which interactive terminal to use

- o Start and communicate with a concurrent process to facilitate simultaneous processing of data

- o Send a message to and start a successive process suspending execution of the application until the successive process completes

- o Log transaction response time for review by the system administrator

Once the application system is in operation, interactive applications are automatically initiated according to the schedule defined by the system administrator via the Customizer. If the schedule defined for application initiation is accurate, no user interaction is necessary

to gain access to application program functions (The appropriate application will be presented to the appropriate set of users at the appropriate time.).

If special needs arise, the system administrator may modify interactive application activity through the System Administrator Interface.

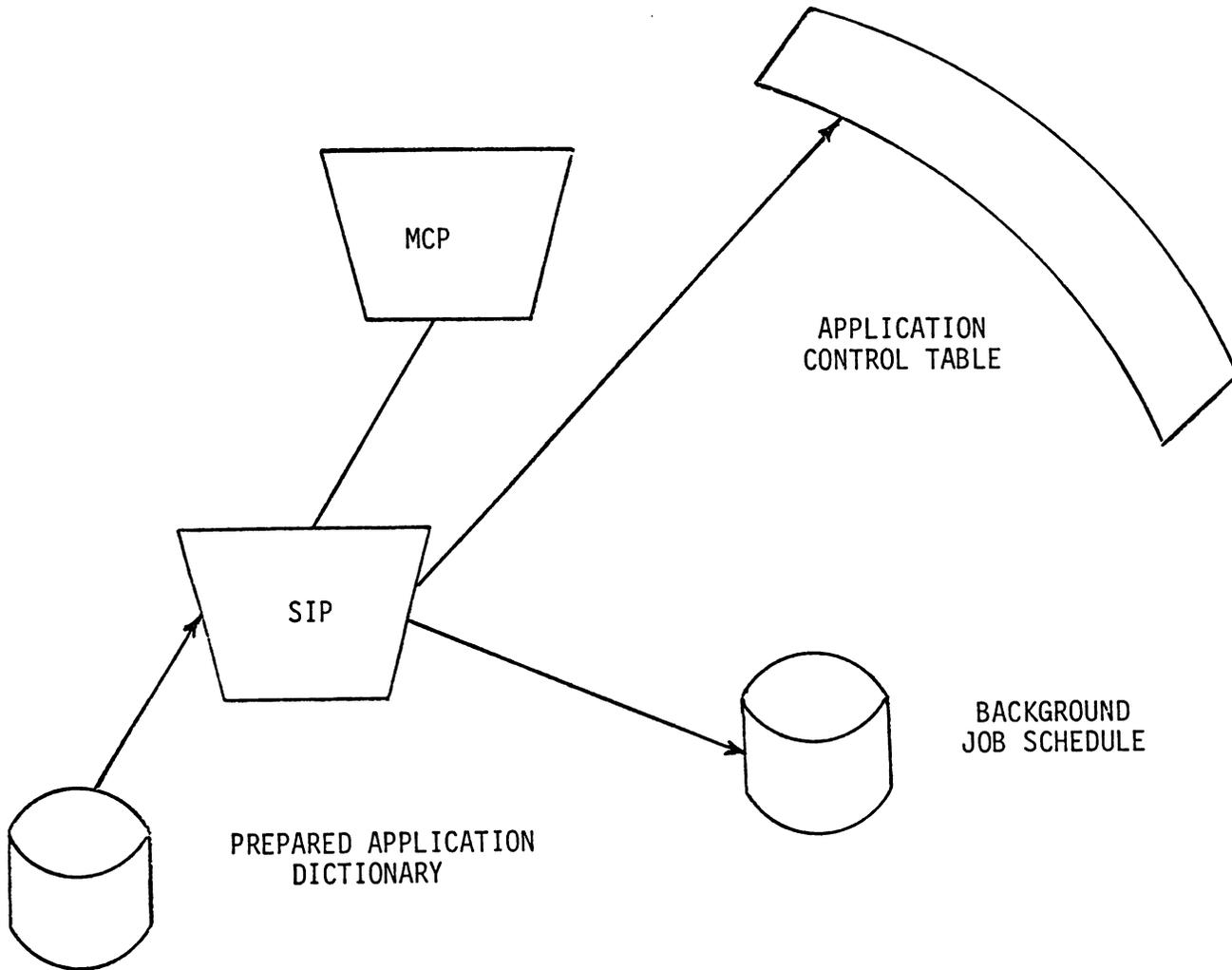Figure 8 depicts the MCP's management of interactive applications.

Figure 7.   Application System Startup

The Monitor Control Process (MCP) is the first program to
run in the application system. Its first step is to launch
the System Initialization Process (SIP). The SIP reads a
prepared application data dictionary generated by the
Application Customizer. From this dictionary, the SIP
builds system-wide tables used in operation and control of
the application system.   The two main tables generated are
the Application Control Table (ACT) and the background job
schedule. Once the tables are initialized, the MCP begins
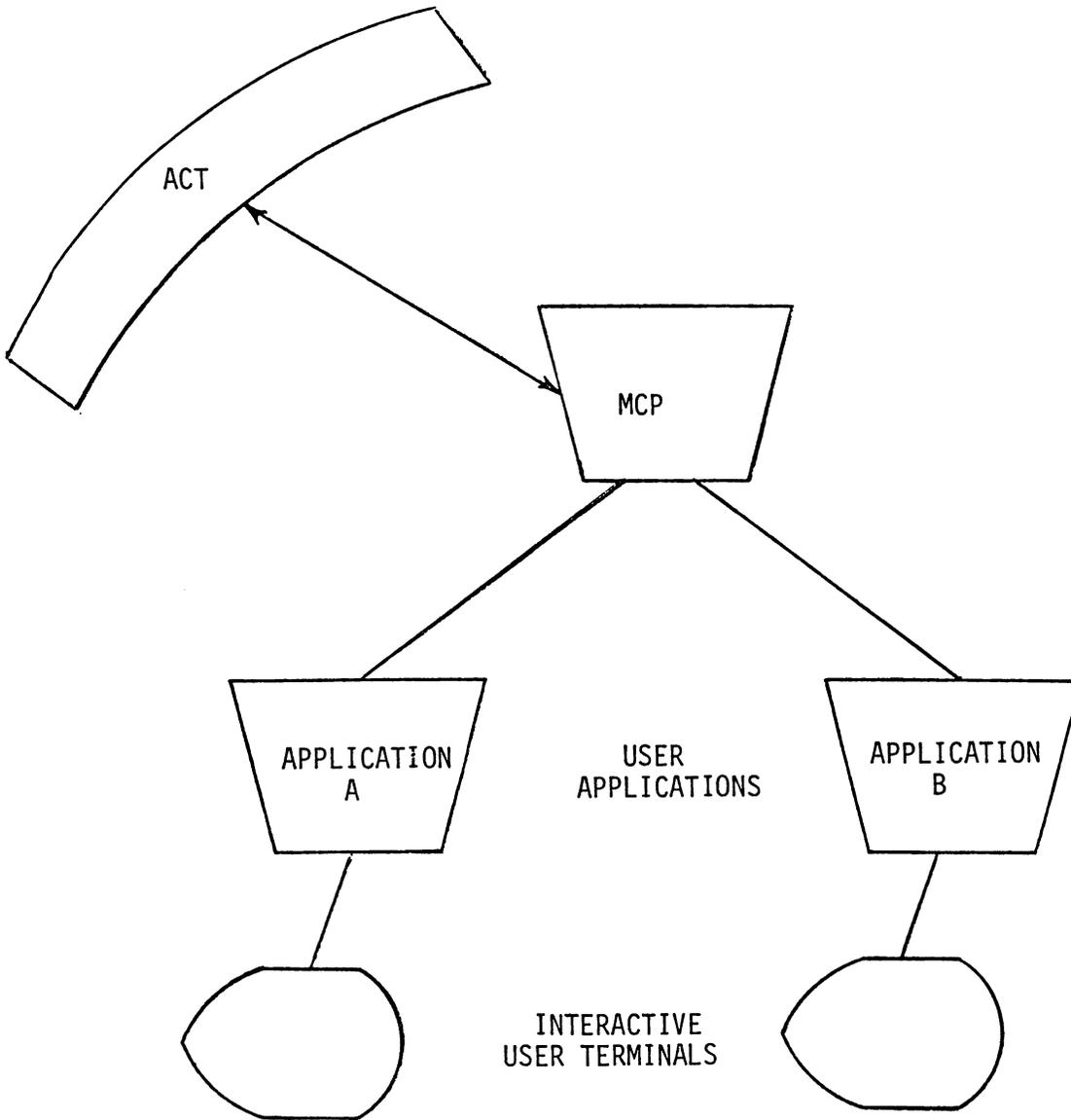normal operation and continues execution indefinitely.

Figure 8. Interactive Application Management

The Monitor Control Process (MCP) reads the Application
Control Table (ACT) built by the System Initialization
Process. According to values initialized in the ACT the
MCP launches application programs for presentation of
application functions to users. The application programs
utilize monitor intrinsics to request services and allow
the system administrator to review and control application
activities.

H. Background Job management

Background jobs are scheduled for execution according to
a job list created by the system administrator via the
customizer. This list is read each day by the System
Initialization Process to determine the jobs to be run
for the current day.

The jobs are automatically executed at the time specified
in the list. If a job fails, predefined recovery
procedures are executed. When intervention is necessary,
the system administrator may modify the execution
sequence of background jobs via the Processing Schedule
Maintenance process.

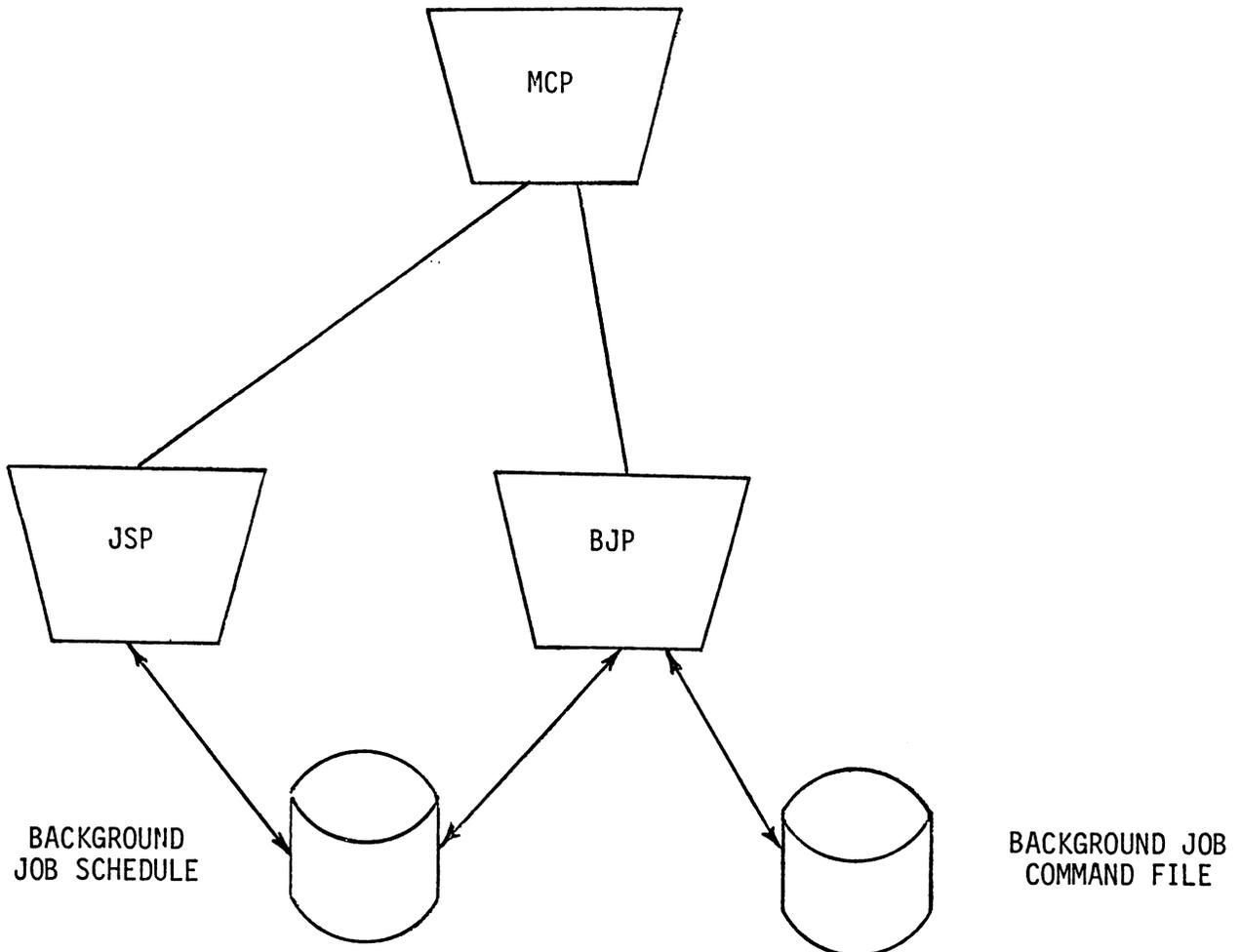Figure 9 depicts Monitor's management of background jobs.

Figure 9. Background Job Management.

The Job Scheduler Process (JSP) reads the Background Job
Schedule to determine which jobs should be scheduled for
execution at the current time. All jobs that have run
times on or before the current time will be scheduled for
execution. The Background Job Processor (BJP) executes a
job by processing that job's command file. Up to three
BJPs may run concurrently allowing concurrent execution of
up to three background jobs. Each job may have recovery
procedures and checkpoints defined. If a job fails, the
recovery procedures are automatically executed and the job
is restarted at the appropriate checkpoint or step.

IV. Conclusion

The automation of an application system can significantly reduce the management time which is required of the administrator of an application system. This allows more time for management of external functions in the environment where the applications are used.

The Application Monitor is a major step in HP's long term commitment to increase the ease of use of application systems.