MANAGEMENT OF PRODUCTION DATA IN
ELECTRONIC PRE-PRESS SYSTEMS

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Abstract: The capital-intensive nature of Electronic
Pre-Press Systems (E.P.P.S.) demands accurate control of
system utilization.

Production studies of Scitex users have shown that most
front-end cost accounting systems do not provide proper
production data feedback for production analysis.
Comprehensive Management Information Sysytems (MIS) built
into Electronic Pre-Press Systems are parochial by nature
and do not integrate well into plant wide MIS systems.

This paper is written to serve as a guideline to Scitex
and other E.P.P.S. users for programing a personal computer
or MIS system to gather and produce comprehensive production
data for all cost centers in an E.P.P.S. department. Since
data can be processed in common P.C. software packages such
as Lotus or DBase III, the program can be easily modified by
the user to reflect differences in definable cost centers
and individual requirements.

Scitex has recently released an automatic event logger
whose accumulated data can be transferred via floppy disc in
IBM PC compatible format. This data can then be combined
with other non-Scitex logged events to enable comprehensive
production analysis. A model production analysis program
has been developed using DBase III. Computer-based time
recording principles along with the event logger and P.C.
production analysis program are reviewed.

Computer-Based Time Recording

Proper production control for an Electronic Pre-Press
system must measure a variety of operations against the
total system capacity. Each system operation requires the
use of a computer set and therefore consumes computer time.
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In most Scitex configurations, two, three or more operations may be occuring concurrently. The criteria for the number of concurrent operations within any system is the number of computers in the configuration. Time accounting must be based upon the system's total computer capacity.

Conventionally, time accounting is based upon the labor hour. Operation times are recorded as a function of a workers time. On the Scitex system, most operations must be initiated by a worker. However, the processing and ending of these operations is often automatic. A single operator may initiate successive operations at different work stations without waiting for the previous operation to conclude. If the operators log in operations showing start and stop times based on their own activity, they cannot possibly account for overlapping times of individual operations. It is the number of computers in the configuration and not the system manning which limits the system's concurrent capabilities.

Rather than accounting for production operations by means of an operator's time sheet, or worker oriented logging system (barcode or keypad), start and stop times are recorded by the work station. These events are independent of operators who may be floating among the work stations.

Each work station must record production details associated with the customer name, job number, operation code, and allow for chargeable and non-chargeable makeovers. Non-chargeable time which may be the result of a variety of reasons must also be appropriately recorded.

Three operational codes are provided for the scan and plotter stations. The first code indicates the work station's primary purpose. For instance, scanning (into the system) at the scan station or plotting at the plotter station. The other two operation codes refer to the use of the work station's computer for purposes not involving its primary piece of hardware.

One operation code is for magtape (archiving) operations and the other is for terminal-generated operations. "Execute" is the operation name used to designate a variety of terminal-generated functions including final page processing (FEXEC).

Where background processing is available, magtape and terminal-generated operations may be queued by the operator and performed concurrently with the workstation's primary function. Accounting for background operations is discussed later in this report.

Console operations are divided into four distinct categories. These operations are:

1. retouching
2. color modification
3. image assembly
4. masking

Like the other work stations, there is also operation codes for magnetic tape and terminal-generated (execute) operations.

When the configuration includes a ①PreSponse, PreSponse activities should be represented by an additional operation code at the scan station rather than treating it as a separate work station. The reason for this is that the PreSponse shares the same computer with the scanner.

The ②Lynart console on the other hand, has its own computer capable of supporting the Lynart console or performing magtape and execute operations like the other computers. The Lynart then is considered a separate work station.

Systems having auto logging capability will have a logging mechanism at each work station. Where auto logging is not available, time sheets (or barcode/keypad stations) are located next to the workstation's terminal. Whoever initiates an operation at any work station will make the appropriate entry. If the operating staff is working as a team, operations at any one work station will be started by different people. The conclusion of any operation may be noted and recorded by a different person than the one who initiated it.

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① PreSponse - Soft proving station with color modification and cropping capabilities.

② Lynart   - Console for page geometry and some assembly functions.

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Non-Chargeable Time

General non-chargeable time should be classified into distinct categories as follows:

1. Idle time (station not in use)
2. Preventive maintenance
3. Down time
4. Calibration (Plotter Linearization, Color Monitor calibration to paper/ink/press etc.)
5. Demonstrations
6. Training
7. Research and Development

With the exeption of idle time, these general non-chargeable times are best handled as standing jobs. Idle time is simply left as blank spaces between operations. It is very important that non-chargeable time be closely monitored due to the capital intensive nature of the equipment.

Non-chargeable time attributed to specific jobs is considered make-over time. Four make-over categories have been defined. One is chargeable while the other three are non-chargeable. The make-over categories are as follows:

a. Author's alterations (chargeable)
b. System malfunction
c. Human error
d. Internal editorial change

Author's alterations is the one chargeable make-over code. At the operator level, it is often difficult to distinguish between chargeable and non-chargeable alterations. The distinction between chargeable and non-chargeable time is important. It is the system manager's responsibility to indicate which make-overs are chargeable and which are non-chargeable.

A system malfunction make-over is distinguished from downtime since the work station is still in operation. An operation may simply have to be repeated. Lost time due to software or hardware problems may be calculated by adding system malfunction make-over time to downtime.

Human error refers to a mistake made by anyone within the production system. Most errors are not directly or entirely the fault of the operator but may be an error of communication or understanding among anyone in the sales and production process. This fact must be stressed to operators in order to encourage honest entries.

An internal editorial change is defined as being similar to an author's alteration with the exception that the decision to make the correction was made internally and not by the customer. Usually, this involves some form of color modification as opposed to an error in image assembly.

Manual Event Logging

To demonstrate the principle by which automatic or semi-automatic time recording should be done, sample manual entry forms are shown here.

The forms have been designed to provide as much accurate information as possible without operators having to memorize a large number of operation codes and without them having to consume unnecessary time filling out the time sheet. On the left extreme of the time sheet are times separated into 6 minute increments (.1 hour). Proceeding from left to right across the sheet are separate columns for each of the operation codes; four columns to indicate make-overs, a column for the job number and the last column for the customer.

At the beginning of an operation the operator places a circle around the nearest incremental time. On the same row as the time, the job number and customer name is immediately entered. No other entry is made on the time sheet until the conclusion of the operation. When the operation ends, the operator places another circle around the corresponding incremental time. A vertical line is then inserted from the start to stop times of the operation in the appropriate column corresponding to the particular operation code.

For example, if the scan station was used to scan a transparency from 07:00 to 08:00 these numbers would be circled with a vertical line connecting the two times in the scan column. If magtaping was done during this time period instead of scanning, then the vertical line would be placed in the second column.

DAILY TIME SHEET

Console Station

PM _	OPERATION CODE							Makeovers				JOB NUMBER	CUSTOMER	OPER.
	MASK	ASSEM	CC	RET	ARCH	EXEC		A	B	C	D			
.5												1111	Maintenance	D.K
.5										✓		3157	Thompson	
													M.O. - Grad in Cyan	
												3158	Doyle / Dane	
TOTAL	1.5	4.8	1.8	3.5	.1	2.0				.5				
TOTAL	13.7							.5						

15 HRS AVAIL

MAKEOVER CODES
A–Authors Alterations
B–System Malfunction
C–Human Error
D-Internal Editorial Change

OPERATIONS CODE
–Assemble –Execute
–Col. Corr –Archive
–Retouch –Masking

Standing Job Numbers
Gen. Non Chargeable Time
–Demonstration
–Preventive Maintenance
–Downtime
–Calibration
–Training
–R&D

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FIGURE 1

DAILY TIME SHEET

Scan Station

15 APR 86
DATE & DAY

AM__		OPERATION CODE					Makeovers				JOB NUMBER	CUSTOMER	OPER.	FILM USE		
	S/UP	CON	SYS	PRE/S	ARCH	EXEC	A	B	C	D				SIZE	TYPE	QTY
1.0 (07:00) 07:06																
07:12																
07:18																
07:24																
07:30																
07:36																
07:42																
07:48																
07:54																
(08:00)																
.1 (18:48)(18:54)		1				1										
19:00																
(19:06)																
19:12																
.2 (19:18)				1												
19:24																
19:30																
TOTAL		5.0	4.0	3.5	1.0	2.5										
TOTAL CPU ONLY			11													

OPERATIONS CODE

–Set Up	–Execute
–Sys. Scan	–Archive
–Conv. Scan	⌐Response

Standing Job Numbers
Gen. Non Chargeable Time

–Demonstration
–Preventive Maintenance
–Downtime
–Calibration
–Training
–R&D

At the end of the day, the time sheet would show vertical lines alternating among the operation codes. The customer name and job number is entered only at the initiation of each operation. The operator may avoid excessive writing by using ditto marks under job number and customer when successive operations are associated with the same job.

Whenever a non-chargeable code is entered on the time sheet, a short description in 3 or 4 words should be placed in the customer column under the entry as shown in figure 1. For both chargeable and non-chargeable time associated with particular jobs, entries are made on the time sheet as before. In addition to the normal entry, a check mark is placed in one of the four makeover columns on the same line as the job number and customer (start of operation).

On the right side of the daily time sheets, extra columns are provided for material usage at the scan and plotter stations. The forms presented here represent only a sample mechanism which should be adapted to the particular configuration and the user's desires.

At the scan station, the scanner operator may have to fill out two different time sheets. One time sheet is for conventional scanning, not using the Scitex System, and the second will be for scanning into the Scitex system. To make things simpler, another column may be added to the scan station time sheet which represents conventional scanning. The example Scan station time sheet (fig.2) shows two non-computer operations. Scanner set-up is separated from actual scanning. When this is done, the time sheet may show one of the other computer operations taking place concurrently with a conventional scan.

The daily time sheets are submitted to the system manager at the conclusion of each shift. The system manager then spends a few minutes reviewing each of the time sheets for discrepancies and notes the production times for each of the operations to the left of the circled numbers. The totals for each of the operation codes at their respective work stations are added up by the system manager or a clerk and entered at the bottom of a time sheet. The time sheets are then submitted to the cost accounting department for entry into the P.C. production control program or the user's management information system.

The time sheets are not discarded but returned to the
system manager for inclusion in a log-book corresponding to
each work station. The design of the daily time sheets
provide a detailed historical picture of system use. For
purposes of future analysis, the system manager can look up
what was happening on the system at any time in its
operational history. This is especially useful when
tracking down the history of problem jobs.

Non-Computer based operations

There are a number of operations in an E.P.P.S.
department which do not make use of the E.P.P.S. hardware.
Obviously, any automatic logging system cannot account for
these operations. They are none the less important for
production analysis. Event logging for these operations is
accomplished by conventional time sheets or semi-
automatically via bar code recorders or keypads. At the P.C.
or MIS stage, computer and non-computer-based data is
combined.

Operations in this catagory include:

1. Conventional Scanning
2. System Planning
3. Film Processing
4. Pre-Press Proving
5. Copy-Camera

Depending on manning conditions and machine set-up,
these and other operations may be grouped into workstations
similar to computer based operations. Here a workstation may
even be a person as the criteria is based on ability to
perfom concurrent operations.
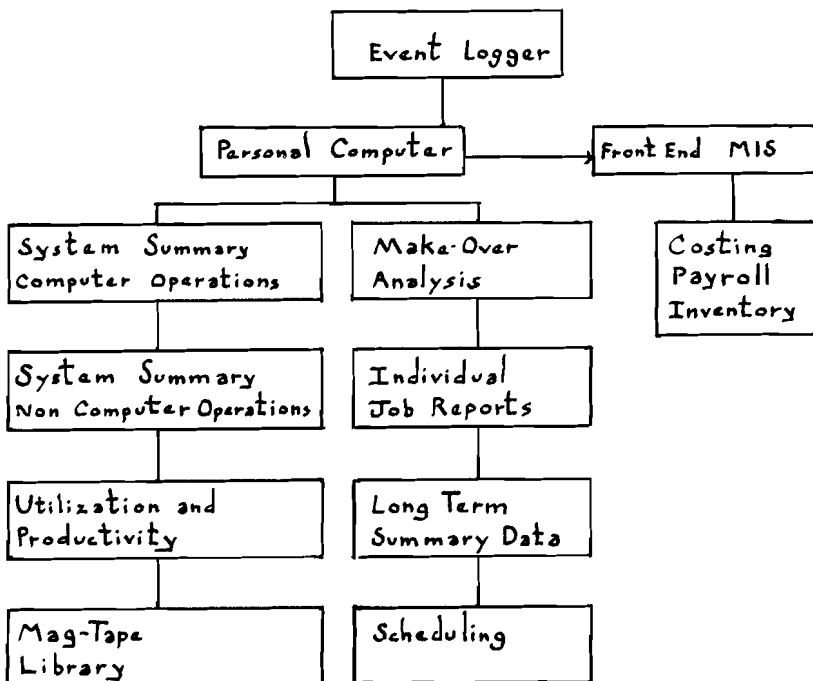
Available Time

Idle time is defined as the difference between all
logged entries of a workstation and the total time the
workstation was available for use. For any measured period
subject to production analysis, an entry must be made by the
system manager to indicate available time. With conventional
time sheets, this entry may be made on the time sheet at the
shifts conclusion.

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Analysis

Most front-end cost accounting or MIS systems provide some type of feedback to production management. The nature of reports provided are often related to individual job costing and payroll rather than production control. Individual job reports showing total time and cost per each operation are most common. Even this type of report may be very misleading if operation times are based on the labor hour instead of the machine (computer) hour.

A single or small set of comprehensive reports is needed which will show a summary of all chargeable and non-chargeable time for each workstation or cost center within a defined production period.

Computerized cost accounting and MIS systems are commonly programed for utilization by administrative and financial personnel. Alterations to the MIS program for department level production control as suggested in this paper may not be easily programed into the MIS by the user. On the other hand, production reports can easily be generated on a personal computer. Other programs such as magtape library control, and scheduling, can be custom designed on a personal computer according to the desires of the department manager.

```
                        ┌─────────────────┐
                        │  Event Logger   │
                        └────────┬────────┘
                                 │
          ┌──────────────────────┴─────┐              ┌──────────────────┐
          │   Personal Computer        ├─────────────>│  Front End  MIS  │
          └──┬──────────────┬──────────┘              └────────┬─────────┘
             │              │                                  │
  ┌──────────┴───────┐ ┌────┴─────────┐              ┌─────────┴────────┐
  │ System  Summary  │ │ Make-Over    │              │ Costing          │
  │Computer Operations│ │ Analysis    │              │ Payroll          │
  └──────────┬───────┘ └────┬─────────┘              │ Inventory        │
             │              │                        └──────────────────┘
  ┌──────────┴───────┐ ┌────┴─────────┐
  │ System  Summary  │ │ Individual   │
  │Non Computer Oper. │ │ Job Reports │
  └──────────┬───────┘ └────┬─────────┘
             │              │
  ┌──────────┴───────┐ ┌────┴─────────┐
  │ Utilization and  │ │ Long Term    │
  │ Productivity     │ │ Summary Data │
  └──────────┬───────┘ └────┬─────────┘
             │              │
  ┌──────────┴───────┐ ┌────┴─────────┐
  │ Mag-Tape         │ │ Scheduling   │
  │ Library          │ │              │
  └──────────────────┘ └──────────────┘
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The preceding diagram shows a path of production reporting from event logging to the front end MIS. Where event logging devices such as barcodes or keyboards are directly linked to the MIS system, production level reporting may be more efficiently done on the MIS.

System Summary

The most useful document for production analysis shows the individual job total times for each operation at each workstation in a user specified period of time. For most operations this period would be one week. At one glance, the system manager can see how much time was spent on any operation for any job. Comparison of operation times among jobs is easily done and helps the system manager to spot irregularities and imbalances to the normal work flow.

At the bottom of the form, operation and workstation times are totaled and averaged. Production data has been segregated into chargeable and non-chargeable time. Total production times by operation and workstation can be compared to spot bottlenecks and compare chargeable times from week to week. To help indicate a general level of efficiency, average time per operation and/or workstation is also provided.

The complexity and nature of one job to another may vary greatly. One job may be a 48 page booklet processed completely within the E.P.P.S. system while another may simply be a single color picture retouched on the system and then combined with other job elements in conventional assembly.

Average operation times by jobs could then be misleading. To provide a more meaningful average, each job is labeled as being equal to a chosen number of equivalent page units. The classification of what constitutes a standard page is left to the system manager. Average operation times are then based on the equivilant page.

The sample system summary sheet seen on the next page shows all chargeable and non-chargeable times for the computer-based operations. Note that all operation times attributed to general non-chargeable codes (P.M.,downtime, calibration, etc.) are listed in the non-chargeable section. General non-chargeable time at the console is listed under one of the four console codes (image assembly). A companion report is made for all non-computer operations.

System Summary - Computer Based Operations   Week of 14 APR 86

			Chargeable Time											Non Chargeable Time										
			Scan Station			Console Station								Scan Station			Console Station							
Customer	Job Numb.	Equip Hours	Scan	Prep	Lymart	Mask	Retouch	Color Med.	Assem	Total Console	Plot	Tape	Exec	Scan	Prep	Lymart	Mask	Retouch	Color Med.	Assem	Total Console	Plot	Tape	Exec
Prev. Maint	0001													.5										
Downtime	0002																					.5		
Calibration	0003														1.0									
Demonst.	0004														.3	.4				.5			.2	
Training	0005													1.0						1.0		1.0		
R+D	0006													.3	.2					1.5		.5	.3	1.0
Sub Total														1.8	1.5	.4					3.0	2.0	.5	1.0
Thompson	3157	2.0	.5	.2		.5	1.0	.5	2.8	4.8	.7	.1	1.5					.5		.5				
Doyle	3158	1.5				1.0	2.5	.8	1.5	5.8	.3	.2	1.5					.3		.3		.3	.2	
Grey	3159	.5	.4	.2			.5			.5	.2	.1												
Sears	3160	10.0	3.8	2.1	2.3	2.5	3.5	3.0	1.0	10.0	2.2	1.1	2.8	.5	.3	.2		.5	.3		.8	.6	.2	.3
Kellog	3161	1.5	1.0		.8	.5	2.0		3.0	5.5	.6	.3	1.0											
BBD+O	3162	1.0	.3	.2	.1	.3	1.5	.5		2.3	.3	.1		.3	.2			.1						
Dorland	3163	4.0	.6	.5		1.3	1.0	1.3	2.0	5.6	.9	.5	.8							.2				
Ogilvy	3164	2.0					1.3	.5		1.8	.4	.2	.1											
P+G	3165	8.0	6.0	1.6		1.2	3.0	1.8	1.2	7.2	1.3	1.3	1.1							.3		.2	.2	
Hearst	3166	5.0	1.5																					
Blair	3167	1.0	.8	.3		1.0	2.0	3.5		6.5	.3	.2	.3	1.6	.6		.5	2.0	2.0		4.5		.4	.3
Total		36.5	14.9	5.1	3.2	8.3	18.3	11.9	11.5	50.0	7.2	4.1	9.1	4.2	2.6	.6	.5	2.5	2.8	.6	9.1	3.3	1.6	1.6
Average			.41	.14	.09	.23	.50	.33	.32	1.37	.20	.11	.25	.07	.03	.01	.01	.07	.08	.02	.17	.04	.03	.02

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System Summary - Non Computer - Operations
Week of 14 APR 86

Customer	Job Numb.	Equiv Pages	Chargeable Time					Sub Total	Non Chargeable Time				
			Conv Scan	Sys Plan	Film Process	Proof	Copy Camera		Conv Scan	Sys Plan	Film Process	Proof	Copy Camera
Prev. Maint	0001								.5			.5	
Downtime	0002										1.0		
Calibration	0003								.5				
Demonst.	0004									.2			.5
Training	0005									.5			.5
R+D	0006								1.0	1.0	.5		
								Sub Total	2.0	1.7	1.5	.5	1.0
Thompson	3157	2.0		1.0	.2	.6							
Doyle	3158	1.5	1.0	.8	.2	.5					.1	.3	
Grey	3159	.5			.1	.3							
Sears	3160	10.0		6.0	1.3	3.0	1.5				.2	1.2	
Kellog	3161	1.5		.7	.2	.5							
BBD+0	3162	1.0	3.0	.3	.5	.3	3.0						
Dorland	3163	4.0		1.2	.4	1.2	.3				.1	.4	
Ogilvy	3164	2.0		.8	.2	.6	.2						
P+G	3165	8.0		3.0	1.0	2.4	1.5				.1	.4	
Hearst	3166	5.0		1.6	.5	1.5	.7						
Blair	3167	1.0		.2	.1	.3							
Doyle	3168	20.0	10.0		2.0	6.0			2.0		.6	1.0	
Simpson	3169	16.0	8.5		1.7	4.8			1.2		.3	.3	
Fisher	3170	3.0	4.3		.3	.9							
Total			26.8	15.6	8.7	22.9	7.2		4.2	1.7	2.9	4.1	1.0

Work Station and System Analysis

On the preceding forms, magtape and execute times were shown for each job but were not differentiated among the work stations. In this report, total chargeable and non-chargeable times for each workstation are shown along with magtape and execute times at each work station. It is important to distinguish where magtaping and execute functions took place in order to assist work flow. Since these to operations can take place at any work station, the bulk of these operations should be shifted away from the bottleneck cost center.

Total production times can then be compared to available time at each work station to derive productivity ratios. Two ratios should be calculated and compared from week to week.

1. Utilization -   defined as all chargeable and non-chargeable time (less idle time) divided by available time.

2. Productivity -   defined as all chargeable time only divided by available time.

The productivity ratio is most usful in developing hourly cost rates for each work station. Actual productivity can be compared each week to estimated productivity upon which existing hourly rates were determined. These two ratios are applicable only to the computer-based work stations.

Utilization and Productivity - Week of 14 APR 86

Work Station	Chargeable				Non-Chargeable							
	Main	Tape	Exec	Total	Main	Tape	Exec	Total	Total	Avail.	Util.	Prod.
Scanner	20.0	.3	1.5	21.8	6.8	.3	.4	7.5	29.3	64	46%	34%
Lynart	3.2	2.0	5.3	10.5	.6	1.0	.8	2.4	12.7	64	20%	16%
Console	50.0	.8	.8	51.6	9.1	0	.1	9.2	60.8	64	95%	81%
Plotter	7.2	1.0	1.5	9.7	3.3	.3	.3	3.9	13 6	64	21%	15%
Scanner	Sys	Presp.	Conv.	Total	Sys	Presp.	Conv.	Total				
	14.9	5.1	26.8	46.8	4.2	2.6	4.2	11.0	57.8	64	90%	73%

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Make-Over Report

Chargeable and non-chargeable make-overs are differentiated into four catagories as previously described. On the system summary report, author's alterations (chargeable) are combined with chargeable time and the three non-chargeable codes are combined for each operation in the non-chageable columns. To help analyse costly make-overs, a separate report for each station shows make-over times for each job separated by make-over catagory. High incidences of non-chargeable make-overs for specific reasons can be isolated and targeted for improvement.

Make-Over Analysis Week of 14 APR 86

Work Station - Console

Job Number	Mask				Retouch				Color Modify				Assemble			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
3157					.3							.5				
3158															.3	
3159																
3160							.5					.3				
3161					.5											
3162																
3163																
3164					1.3				.5							
3165														.3		
3166																
3167			.5				1.0	1.0	2.0			2.0				
Total			.5		2.1		1.5	1.0	2.5			28		.3	.3	

Automatic Event Logger

The Event Logger provides for automatic logging of computer based operations. A time base generator is located in each CPU. Transfer of all event data from the previous transfer time to the present time is initiated by the system manager. Data can be transferred to a line printer or to floppy disc separately for each CPU. Alternatively, the event data from all CPUs in the system can be merged onto one report.

If production data is processed on a PC, intermediary MIS, or front end MIS system as described in this paper, then only raw event data is passed on. A print-out of tabulated data showing total times for each operation (job by job) is also available as shown in figure 8.

Once production data has been passed from the Scitex system to the floppy disc or line printer, event data is purged in the Scitex system.

Background Processing

Background processing enables many of the terminal generated operations along with magtape operation to share CPU time with the work station's primary function. When an operation is to be processed in the background, the operation is queued by the operator so that the operator can initiate a foreground operation before the other operation begins. Two computer based operations can now take place on the same CPU concurrently.

The automatic event logger will record actual times of both background and foreground operations. Without automatic event logging, accurate monitoring of background operations is difficult. The effect of background processing on utilization and productivity calculations is to provide additional available CPU time. Since operations queued for background processing assume the forground position when another forground operation is not taking place, it is difficult to program a specific increase in available time.

The simplest way to handle background processing times in utilization or productivity calculations is not to add available time and treat background operations like all others. An increase in the productivity ratio can then be expected. Potentially, utilization and productivity could be over 100 per-cent.

Event Logger Tabulation

STATION NAME: Console A

TOTALS	Hours	Min	Sec
Available Time	15	00	00
Direct Charge	12	37	00
Author Alterations	00	00	00
Non-Chargeable	01	00	00
Idle	01	23	00

JOB NUMBER 1111   CUSTOMER Maintenance

Assembly (N)	00	30	00

JOB NUMBER 3157   CUSTOMER Thompson

Assembly	02	45	30
Masking	00	30	00
Retouch	01	00	00
Color Mod.	00	30	00
Color Mod. (N)	00	30	00
Mag Tape	00	06	00
Terminal	00	30	00

JOB NUMBER 3158   CUSTOMER Doyle/Dane

Assembly	01	30	30
Masking	01	00	00
Retouch	02	30	00
Color Mod.	00	45	00
Mag Tape	00	00	00
Terminal	01	30	00

Report Period:	Day	Month	Year	Hour	Min	Sec
Start	15	04	86	00	00	00
End	15	04	86	15	00	00

Figure 8

Personal Computer based analysis Program

The PC program has been written in DBase III software and follows the guidelines previously described. Four Schedules are provided to allow entry of data and two reports are derived from the data. The main menu is as follows;

    1.   Entry Log
    2.   Available Time Entries
    3.   Close Reporting Period
    4.   Open New Reporting Period
    5.   System Summary Report
    6.   Work Station Report

If the user has the automatic event logger, then operation entries need not be keyboarded into the P.C. As output from the event logger is recorded on an IBM PC disc, the PC program can take the data directly from disc. Supplemental keyboarded entry data is still needed for non computer operations.

Since the schedules and reports are formatted to print out on standard IBM matrix printers, there is a limitation in line width. The System summary report is divided into three print outs which can afterwards be arranged side by side. The three print-outs are;

    1.   Computer based operations - chargeable
    2.   Computer based operations - non-chargeable
    3.   Non-computer based operations - chargeable and
                                        non-chargeable

Conclusions

Recording of production data on E.P.P.S. systems can be automatic, semi-automatic, or manual. By whatever mechanism is used, operations should be recorded as a function of computer rather than labor capacity. Non-computer based operations need to be recorded and combined with computer based operations to allow comprehensive analysis of production in an E.P.P.S. department.

The event recording and production data processing procedures described in this report do not represent a complete MIS system or a rigid program. This report is intended to be used only as a guideline for programing a personal computer, an intermediary MIS, or front end MIS system to accurately present E.P.P.S production data. The procedures presented here can easily be taken a step further to provide accurate cost analysis.