INTRODUCTION

In most organizations or industries, it is necessary to carefully plan and monitor involved projects. These projects often consist of a number of tasks which must be completed within specific time frames. To effectively manage such projects, some type of scheduling chart is required - something that will give an accurate overview of the lifespan of the project.

One of our clients at ACT Computer Services had a requirement for such a scheduling chart. The chart was currently being done by the client by calculating the coordinates for all task start and end dates, grid lines, titles, and task positions, then using a BASIC program to drive a plotter. The entire process took up to two weeks to complete using this semi-manual method.

In response to this need, the Information Centre staff at ACT developed a full-screen application which guides a non-data processing person who is unfamiliar with SAS through the steps of preparing such a scheduling chart. With the use of dialogues, the user is prompted on the types of tasks to be performed, the time periods involved for the tasks, and any special notes or titles that are to appear on the scheduling chart. An additional feature of this system is the ability to overlay a "cash-flow" plot upon the project grid. This option graphically displays the funding of the project throughout the effective time period of the scheduling chart. A complete grid is displayed in Figure 1.

<table>
<thead>
<tr>
<th>PHASE 1 SYSTEM IMPLEMENTATION</th>
<th>1983</th>
<th>1984</th>
<th>85</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETAIL DESIGN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONSTRUCTION AND TESTING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INSTALLATION AND TRAINING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUTOVER TO PRODUCTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE 2 SYSTEM IMPLEMENTATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DETAIL DESIGN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONSTRUCTION AND TESTING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INSTALLATION AND TRAINING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUTOVER TO PRODUCTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE 3 DESCRIPTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE 4 DESCRIPTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE 5 DESCRIPTION</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MANAGERS RESPONSIBLE:
- A. JONES
- S. WILLIAMS
- W. MACINTIRE
- E. HARRISON
- G. MACLEOD
- K. EVANS
- V. OGANOSKI

FIGURE 1 - Sample Scheduling Chart
COMPONENTS OF THE SCHEDULING CHART

Titles: The scheduling chart has allowances for seven different titles that can be determined by the user:

- The main project title centered at the top of the page, with an area for the date (right-justified).
- Four descriptive title lines, left-justified.
- The task title line centered above the task grid area.
- The cash-flow title running along the right side of the chart.

Two additional title lines are automatically generated by the scheduling system—the year and month title lines located beneath the task title line. The scale for these titles depends on the minimum and maximum dates within the task planning data. Although the scheduling system will attempt to produce a chart over any time period, it operates most effectively for projects from 2 to 36 months in duration.

Task Descriptions: Up to 24 task descriptions can be entered, each being up to 30 characters in length. If more descriptions are required, the scheduling chart could be broken up into a series of distinct charts, and page numbers could be substituted for the date in the upper right corner of the chart.

Task Planning Lines: Any number of "start-end" dates can be entered for a given description (see "Phase 3 Description", Figure 1). The position of these dates are accurate relative to their position within the grid cell. For example, in comparing the planning lines of "Phase 4 Description" with "Phase 5 Description" it can be seen that the line for PHASE 5 starts slightly after the planned start date for PHASE 4, yet the lines are the same length. This is the result of PHASE 4 having start-end dates of 05JUL83 and 05AUG84 while the dates for PHASE 5 are 20JUL83 and 20AUG84 respectively.

Cash Flow Line: This extra feature allows users to track the cumulative amount of dollars spent during the effective time period of the project. The program determines the maximum value entered, and automatically generates a scale along the right side of the chart.

USING THE SCHEDULING SYSTEM

The interactive system was written in a high-level, structured programming language under ROSECO, a program development facility.

The primary screen (Figure 2) allows the user to select one of four options:

1. Enter task descriptions, as well as their start and end dates.

The interactive system first prompts for a partitioned or sequential OS dataset in which the task descriptions and start-end dates can be entered. Once the user has provided a valid dataset name, the panel in Figure 3 is displayed, and the descriptions and dates may be entered or updated. The panel also displays a summary of the PF key functions that can be used. Once the descriptions and dates have been entered, hitting PF3 will cause the data to be saved in the OS dataset, and control will return to the primary screen.

2. Enter the cash flow dates and amounts to produce the cash flow plot.

The user is once again prompted for a valid partitioned or sequential dataset name, then the panel in Figure 4 is displayed. Now the user may enter a date with a corresponding Y-value (amount). These values will be sorted by date, then plotted on the scheduling chart.

3. Produce the entire job control language and SAS program that will create the chart image in a SAS dataset.

Once the data has been entered with Options 1 and 2 above, the scheduling chart is ready to be produced. Headings for the chart are entered with another panel, then the user is prompted for dataset names and jobcard information with the panel shown in Figure 5. Once all the fields have been entered and verified the program is submitted and the image of the graph is stored in a SAS dataset. The SAS/GRAPH Scheduling Chart User’s Guide then instructs the user how to activate interactive SAS through TSO and use "PROC GREPLAY" to display the resulting chart image.

4. End the interactive session.
INTERACTIVE DIALOGUES

SAS/GRAPH SCHEDULING SYSTEM
HOME PANEL

PLEASE CHOOSE AN OPTION ==>
1. CREATE/UPDATE SCHEDULE DATA
2. CREATE/UPDATE CASH FLOW DATA
3. CREATE SCHEDULE IN SAS/GRAPH DATASET
9. END

FIGURE 2 - Primary Panel

SAS/GRAPH SCHEDULING SYSTEM
CREATING/UPDATING SCHEDULE DATA

<table>
<thead>
<tr>
<th>LINE NUMBER</th>
<th>DESCRIPTION</th>
<th>START DATE</th>
<th>END DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PHASE I SYSTEM</td>
<td>01JAN83</td>
<td>01MAR83</td>
</tr>
<tr>
<td>2</td>
<td>DETAIL DESIGN</td>
<td>01JAN83</td>
<td>01MAR83</td>
</tr>
<tr>
<td>3</td>
<td>CONSTRUCTION</td>
<td>10MAY83</td>
<td>01DEC83</td>
</tr>
</tbody>
</table>

FIGURE 3 - Entering Schedule Data

SAS/GRAPH SCHEDULING SYSTEM
CREATING/UPDATING CASH FLOW DATA

<table>
<thead>
<tr>
<th>LINE NUMBER</th>
<th>DATE</th>
<th>Y VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>01JAN83</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>01FEB83</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>01MAR83</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>01APR83</td>
<td>500</td>
</tr>
<tr>
<td>5</td>
<td>01MAY83</td>
<td>850</td>
</tr>
<tr>
<td>6</td>
<td>01JUN83</td>
<td>1150</td>
</tr>
</tbody>
</table>

FIGURE 4 - Entering Cash Flow Data

SAS/GRAPH SCHEDULING SYSTEM
CREATING/UPDATING SCHEDULE DATA

SCHEDULE DATASET (CAN INCLUDE MEMBER IF PDS)
DSN ==> CO055S20.PROJECT.DATA
CASH FLOW DATASET (CAN INCLUDE MEMBER IF PDS)
DSN ==> CO055S20.CASH.FLOW.DATA
SAVE DATASET MEMBER ==> MYCHART1
DEVICE TYPE ==> TEK4662A
JOB NAME ==> #PROJECT CLASS ==> A
CHARGE CODE ==> 00520NT TIME ==> 3
PROGRAMMER NAME ==> RON BOEHM MSGCLASS ==> T

FIGURE 5 - Dataset and Jobcard Information
The program that creates the scheduling chart is actually two distinct SAS programs—the first writing the second with the use of "PUT" statements. This method was chosen because it allowed the program to calculate an aesthetic scaling factor so that only the months in the task start-end dates would be displayed. For example, if the project in Figure 1 were reorganized to take place over the next 11 months, a different scaling factor would be used, and the year and month title lines would be readjusted (Figure 6). If the planned project was to take place during the next five months, the program will draw additional grid lines to delimit the 7th, 14th, and 21st of each month so that a greater degree of accuracy can be determined when the chart is viewed (Figure 7).

The program starts by reorganizing the task start-end dates and cash-flow data into a workable form for later steps in the program. Once this is done, the earliest start date, the latest end date, and the maximum cash-flow amount are determined so that the scaling factors for the chart and cash-flow axis can be calculated. The program then commences to use "PUT" statements to write the second SAS program:

```
93 PUT @1 'GOPTIONS DEVICE=IBM3279
   COLORS=(8G R G B)
   VPOS =32
   HPOS =73;
94 PUT @1 'PROC GSLIDE GOUT=PROJ_GRID';
95 PUT @3 'TITLE';
96 X = 37 -
   LENGTH('THIS IS THE MAIN HEADING')/2;
97 PUT @3 'NOTE .C=R .M=(' X 4.1 " 31)
   'THIS IS THE MAIN HEADING';
```

The VPOS and HPOS are set to 32 and 73, respectively. These numbers are used in later statements (such as statements 95-97 above) to determine the location of text, start-end dates, and monthly boundary lines. The program then calls "PROC..."
### Project Schedule

<table>
<thead>
<tr>
<th>Phases</th>
<th>System Implementation</th>
<th>Detail Design</th>
<th>Construction and Testing</th>
<th>Installation and Training</th>
<th>Cutover to Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
</tr>
<tr>
<td>Phase 2</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
</tr>
<tr>
<td>Phase 3</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
</tr>
<tr>
<td>Phase 4</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
</tr>
<tr>
<td>Phase 5</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
<td>J F M A M</td>
</tr>
</tbody>
</table>

**Managers Responsible:**
- A. Jones
- S. Williams
- W. MacIntire
- E. Harrison
- G. MacLeod
- K. Evans
- V. Oganoski

---

**GSLIDE** in conjunction with a series of "NOTE" statements to position the text. The ".M" parameter of the "NOTE" statement is used extensively for this purpose. The chart lines themselves are also drawn with the use of "NOTE" statements, however they make use of the ".D" parameter:

```sas
PUT 'NOTE .D=(31,2,31,28,67,28,67,2);'';
PUT 'NOTE .D=(31,27,67,27);'';
PUT 'NOTE .D=(1,2,1,26);'';
DO I=2 TO 26 BY 1;
   PUT I NOTE .D= (1, I 2, 1, I 2, 67#)';
END;
```

The above statements result in the basic chart shown in Figure 8. The remaining month lines, task schedule lines, and cash flow line are created by using the scaling factors determined by the minimum and maximum task start-end dates. In total, the first SAS program consists of 211 SAS statements resulting in the second SAS program - approximately 200 SAS statements in length.
FUTURE PLANS

We've had great success with the use of the scheduling chart system as described in this paper, however we plan to enhance the system in several ways, as well as make the interactive aspects of the system even more user-friendly.

At present the cash-flow amounts are entered as an independent dataset with little regard to the task start-end dates. We hope to associate an amount field directly with each pair of start-end dates, then sum these amounts over all task descriptions by month. The plot would consist of each monthly sum cumulating throughout the duration of the project. Another plot calculated in a similar manner, could be drawn up by summing the total number of man-days per month over the term of the project. Both plots would yield more information about the project by effectively summarizing the task start-end data into a line plot.

We've already started the translation from the ROSCOE Programming Facility (RPF) language to PL/I programs that will run interactively in TSO. These programs will use SPF table elements so that data entry will be easier and quicker - an important consideration when the user group consists primarily of non-DP personnel. Eventually we hope to summarize the code into a simple SAS procedure so that the user would only have to enter something such as "PROC GPLANNER," to format a scheduling chart.

In its present state, the scheduling chart system is effective for projects that are about to begin - but what about the monitoring of projects in progress? This becomes especially important over a long term project. What are the bottlenecks? Who is responsible? How will a slow down in one task effect the completion of others? We plan to assist users in finding answers to these questions by providing a facility for overlaying the planned project schedule with an actual project schedule. The result would be a single scheduling chart with the planned task lines (in blue) slightly above the actual task lines (in red). This would give a more complete picture of a project in progress and provide assistance in making decisions. Although the scheduling chart system won't complete your project for you, it can make the planning and management phases of the project much easier and more effective.

For more information regarding the SAS/GRAPH Scheduling System, contact Ron Boehm or Sandy Hemphill at:

ACT Computer Services Ltd.
11735 - 170 Street
Edmonton, Alberta, Canada
T5M 3W7
Phone: (403) 451-5555
Telex: 037-2297