PRODUCING TECHNICAL MATERIALS
WITH THE AID OF SAS ® SOFTWARE

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ABSTRACT

This paper focuses on the development of course materials at SAS Institute and describes the features of the Education Division's Course Composition System, a system developed at the Institute for the production and maintenance of course materials. The discussion centers on system capabilities that allow SAS programs, output, screen images, and graphics to be included in text, and how these features are provided using IBM's ISP F product, base SAS®, SAS/DMI®, and SAS/GRAPH® software. The structure of the system is discussed, along with benefits of its use from a time and cost perspective. Although the primary use of the Course Composition System at the Institute is in the development of course materials, the system could be equally useful for preparation of professional papers, presentations, or any type of technical materials.

INTRODUCTION

Developing Technical Materials

Many of the problems encountered by course developers at SAS Institute are problems shared by writers of technical documents in any environment devoted to training, research, or analysis. Whether the environment is academic, business, or industry, the development of technical documents is complicated by the types of materials that must be included in text. Analytical results are more convincing when documented in written reports by actual programs, output, and graphical results. Training materials are more effective when examples of programs, output, and screen images are included in the text.

At the Institute, it is the responsibility of the Education Division to develop new courses, revise and update existing courses, and develop relevant course materials. SAS programs, logs, and output comprise a major part of each Institute course. Before inclusion in course materials, SAS programs must be tested to be sure they are free of programming errors. For any course referencing multiple operating systems, SAS programs must be tested on each operating system referenced. Course materials related to the SAS Display Manager System and full-screen products, such as SAS/AF® and SAS/FSP® software, must contain accurate screen images from both mainframe and PC versions. Other types of mainframe and PC screen images from SAS and non-SAS products must often be included in course materials. Another requirement is the ability to include graphics images from SAS/GRAPH software and other mainframe or PC products.

Historical Perspective

Historically, the production of course materials at the Institute was a two-stage process and demanded tremendous time commitment from the staff of both the Education and Publications Divisions. The first stage was a preliminary text produced by the Education Division in book form, but not typeset. The second stage was an optional typesetting stage, involving the Publications Division.

In the preliminary stage, SAS sessions were initially simulated in the text using a text editor, with the screen border added by simulation or by paste-up. Eventually, the ability to capture and print mainframe screens was developed, but screens still required paste-up for inclusion in the text. SAS programs, logs, and output were copied into a text editor for inclusion in the book. PC screens could be dumped, printed, and pasted up, but any screen image still required the additional paste-up of a border to simulate the actual screen as viewed by the user. The preliminary form of the text was used in teaching the course while being revised and improved. This form was used on a temporary or permanent basis, depending upon whether resources were available for putting the text in typeset form.

If the decision was made to produce a text in typeset form, the typesetting process added about three months to the production process for the text. In time, production of course materials grew to consume two-thirds of the Publications Division's typesetting staff time. With the addition of typesetting codes and the tedious paste-up process, often the production process introduced new errors into text and SAS code. Checking for original errors and errors introduced by the production process involved two to three rounds of examination, each round including several staff members. Due to prohibitive time and expense, many books were never typeset, and the Education Division was forced to exercise selectivity in deciding which new courses to develop.
These problems provided the impetus for development of a system which would link the editing environment to the environment in which SAS programs, logs, and output were being produced.

Current Perspective

Currently, through the use of the Course Composition System (CCS), most of the time-consuming typesetting and paste-up tasks have been eliminated. The Course Composition System was designed by the Education Division’s Special Projects Department for use in developing course materials. The system provides an interface with IBM’s Interactive Structured Program Facility (ISPF) and programs written in base SAS software, CLIST, PL/I, C, and SAS/DMI software. An on-line environment is provided in which developers can structure and compose course materials. Some features of the system are:

- automatic page numbering
- automatic formatting of the table of contents
- automatic formatting of the index
- ability to test SAS programs and view log and output within the system
- ability to capture SAS programs, logs, output, screens, and graphics for insertion into the text
- access within the system to the ISPF editing facility
- spell-checking ability
- capabilities for global text changes
- ability to archive and retrieve all or parts of course text.

A relatively new enhancement provides for the development of an Instructor’s Guide containing administrative information and instructional information corresponding to each page of the course text.

Through IBM’s Resource Access Control Facility (RACF), read access for all course materials is given to all Education Division staff. Write access for each course is given only to developers of the course. When responsibility for development is shared among several staff members, the system allows for parts of the materials to be distributed among several work areas and later combined for the production version of the text.

Hardcopy for drafts is routed to a line printer or an IBM 6670 laser printer. Hardcopy of the final production version is routed to an IBM 3820 laser printer, which produces a camera-ready version of the final text, including programs, output, screens, and graphics. The print quality of the 3820 printer, with the ability to vary point size, print screens and graphics, and include code, output, screens, and graphics directly into the text, has eliminated the typesetting and paste-up process entirely for most course materials. Use of an optical scanner allows artist-produced graphics to be captured on a personal computer, uploaded to the Course Composition System, and included in text without need of paste-up.

DEVELOPING COURSE NOTES USING CCS

Outline Structure of CCS

Within the Course Composition System, the course structure is an ISPF table. The table structure is very similar to a SAS data set, with the exceptions that character variable values can be any size, 0 to 32K bytes, and extension variables can be added to any row. This table represents the organization of the course rather than the actual content. To create the table for a specific course, the user selects the EDIT option from a main menu and selects the course to edit from a panel displaying the user’s write-access course catalog. The Course Outline panel for the selected course is displayed, allowing the developer to enter lines corresponding to the structural components of the course. The titles of the components are entered with the TYPE entry corresponding to the name of the organizational component, that is, CHAPTER, SECTION, TOPIC, or CONCEPT. SAS programs are entered with a type of SASPGM, screen images with a type of SASSCR, and graphics images with a type of SASSGRF.

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Screen 1 Course Outline Panel
Entries created on the outline panel correspond
to the rows of the ISPF table, and the column
entries for TYPE and TITLE correspond to
columns (variable values) in the table. TOPIC
or CONCEPT entries correspond to the text
components of the course. When text is
entered for a TOPIC or CONCEPT, a member of
a partitioned data set containing the text of the
course is automatically created, and the member
name becomes a value for the variable MEMBER
in the table row corresponding to the TOPIC or
CONCEPT. CHAPTER and SECTION entries
reside in the table for organizational purposes
and provide the TITLE text for chapter and
section headings when the materials are
printed. There are no related members in the
text data set for these entries, and only the
title itself can be edited from the outline. All
panels displayed within the Course Composition
System, whether displayed for menu selection,
catalog selection, outline maintenance, or text
entry, are standard ISPF panels.

When a course is selected for editing, a CLIST
program is automatically invoked that makes all
appropriate file allocations for the data sets
designated to contain text, programs, screens,
or graphics. The CLIST then runs a program
written in C language that interfaces with ISPF
to provide all outline maintenance functions,
such as inserting lines, deleting entries,
renumbering pages, rearranging entries, and
moving or copying entries within or across
courses. These functions are provided by the
C program in response to commands executed
from the outline panel. Outline commands
prompt the C program to invoke the appropriate
ISPF service to accomplish a particular task.
For example, if the M command is issued to
move an outline entry from its present position
to a new location five lines down in the outline,
the C program interfaces with ISPF to issue a
series of function calls that rearrange the rows
of the table.

Line commands Line commands issued from
the outline panel execute the typical editing
functions of selecting, inserting, deleting,
moving, copying, and repeating lines. Each
command invokes the appropriate ISPF service
to perform the required outline maintenance
function. The following commands, however,
are unique to the Course Composition System.

ARCHIVE stores outline items in an
archive file and prevents
display of these items in the
course outline.

COPY allows copying of material
from any other course to
which the developer has read
or write access.

FOOTNOTE places specified text at the
bottom of each page within
the outline entry.

GOALS opens an edit panel for
entering text to be included
in the instructor's guide.

KEYS opens a panel for defining
keywords used to create the
index.

RECEIVE moves material from another
course to the current course
outline.

RESTORE allows previously archived
material to be brought back
into the current outline.

SEND moves outline entries from
current course to a target
course.

Command-Line Commands Standard primary
ingeating commands can be entered on the
COMMAND line of the outline panel. The
following are of particular use in maintenance of
the outline structure.

CONTENTS sends a copy of the table of
contents to a printer or data
set.

INDEX creates the index and sends
it to a printer or data set.

MEMLIST displays the member names in
the MEMBER/PAGE column of
the Course Outline panel.

RENUM recalculates and displays page
numbers of outline entries in
the MEMBER/PAGE field of
the Course Outline panel.

Instructor's Guide

An Instructor's Guide for a course can be
created within the outline panel for the course.
The guide is structured within the system in
two components: administrative material and
information that parallels the course text. For
each specific page of the course text,
explanatory material for the benefit of the
instructor is included in an additional text
member. The development of the structure and
text for the Instructor's Guide is coordinated
by the same program providing the ISPF
interface for all other course outline
maintenance.

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SAS PROGRAMS, LOGS, AND OUTPUT

Creating and Testing SAS Programs

SAS programs to be included in course text are entered and tested within the Course Composition System. Programs are entered by creating an entry in the outline with a TYPE of SASPGM. Selecting the SASPGM entry for editing prompts the display of an EDIT panel for entry of the program code. A command can then be issued that invokes the SAS System and immediately executes the program from within the EDIT panel. The SAS log and output can then be viewed allowing quick program debugging from within EDIT mode.

Screen 2 Program Edit Panel

The Tagging Process

To capture the SAS program, log, or listing file for inclusion in the course text, the TAG command is issued from the outline panel opposite the SASPGM entry. The TAG command executes a CLiST which, in turn, invokes the SAS System from within the Course Composition System and displays a panel that allows for selection of source code, log, or listing file to be captured. When the selection is made, a member in the text data set is created, the selected files are stored in the member, and a member name is automatically assigned. On the row of the ISPF table corresponding to the SASPGM entry, the contents of a field named STATUS indicates which types of output were selected to be captured. The SAS SOURCE/LOG/LISTING screen then displays the selected output types, so that individual lines can be selected to be included in the text. A selection code is added at the end of each line and stored with the output file to be read by a print program when the text is printed.

Screen 3 Program Selection Screen

Screen 4 Log Selection Screen

SAS programs can also be entered and executed on a PC and uploaded to the Course Composition System to be included in course materials. The SAS FILE command is used to store the SAS program, log, and listing files on a diskette. The filenames must have extensions of .PGM, .LOG, or .LST, and a catalog file must be created containing the names of the files and the SASPGM titles from entries on the outline panel whose corresponding text members will contain the uploaded files. A standard micro-to-mainframe communications software package is used in combination with a C program written at the Institute to upload the files to the Course Composition System. During the uploading process, a CLiST directs the files to the proper member in the text data set.

Referencing SAS Program, Log, or List Files

To include the SAS files in the course text, a TAG command must be inserted in the text at the location where the SAS code, log, or listing should appear. This command references the code stored on the individual lines during the tagging process and the title specified on the Course Outline entry whose member contains the
stored files. A tagtype of SASPGM, SASLOG, or SASLST is also specified to indicate which file is being referenced. When the text is printed, the TAG command is read and interpreted by the print program to include the appropriate output at the designated location.

Display manager screens created on a PC can also be included in course text. A screen dump program is used to dump the screen images to a file from the PC display manager session. These images can then be converted and uploaded to the Course Composition System using techniques similar to those described for SAS programs.

Referencing Display Manager Screens

Display manager screen images are referenced for printing by inserting a TAG command in the text at the location where the screen image is to be displayed. The TAG command includes references to the number of the screen within the member, the name specified in the TITLE field of the SASSCR entry, the number of lines in the screen, and the title to be printed under the screen image.

Producing Transparencies

The SLIDES command is used to produce color transparencies from captured screen images. The command is issued from the outline panel opposite a SASSCR entry. Panels are displayed to allow specification of output type and screen positioning. After these specifications are made, a SAS DATA step is executed that reads the data-stream form of the screen image, along with color attributes, and produces an ANNOTATE= data set. This data set is then processed by the SAS/GRAPH GANNO procedure to produce the color slide.

CAPTURING GRAPHICS IMAGE FILES

SAS/GRAPH® Images

Graphics images are created and stored from a SASSGRF outline entry. When the entry is selected for editing, a GOPTIONS statement necessary for capturing the image is automatically included on the EDIT panel. The SAS code necessary to produce a single graphics image is entered on the EDIT panel and can be tested interactively in the same manner as SASPGM entries. The image is stored for inclusion in the text by issuing the TAG command from the SASSGRF entry in the same manner as for tagging the SASPGM entries. If a graphics terminal is used, the PLAY command is also used to preview the graphics image. For the graphics image to be correctly interpreted by the 3820 printer, the PROMOTE command must also be executed for the SASSGRF entry. This command stores the

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image in an IBM graphics image library in the form necessary to be pulled into the course text during the printing process.

Scanned Images

Graphics images can also be read and converted by an optical scanner interfaced with a personal computer and uploaded to the Course Composition System. At the Institute, the ZSoft graphics drawing product PC Paintbrush® is used to interpret the scanned image. The graphics image is converted to a PC Paintbrush file in positive integer binary form and is then uploaded to the Course Composition System in that form. A SAS DATA step then reads the file and uses PUT and FILE statements to write a SAS/GRAPH program that will reproduce the graphic image. This program can then be run and tagged in the same manner as other SAS/GRAPH programs. The PROMOTE command must be executed for these PC images also, in order to include them in the IBM graphics image library.

Referencing Graphics Images

The TAG command used to reference SAS/GRAPH program, log, or listing files is identical to the command used to reference SASPGM entries. The TAG command used to reference the actual graphics image, however, must specify the name corresponding to the TITLE field on the outline entry, placement of the image on the page of text (top or bottom), and whether the graphic is to be produced in black and white or color.

PRODUCING HARDCOPY

Commands can be entered from the command line of the Course Outline panel to produce a camera-ready copy of the text, the table of contents, the index, or the Instructor’s Guide. Each of these commands invokes SAS/DMJ software to provide an interface for executing ISPF function calls from a SAS DATA step. A DATA step is then executed which processes the table and uses PUT and FILE statements to produce a snapshot of the portion of the table relevant to the type of output specified by the print command. For example, only entries with a TYPE of CHAPTER or SECTION would be relevant in printing the table of contents. A SAS batch job is then run to process the snapshot and print the text. The first DATA step in the batch job reads all of the table information, and following DATA steps process the information and read appropriate members corresponding to text, screens, or graphics. This program also inserts Waterloo SCRIPT commands to format text, includes segments from the library containing screen images, and invokes SCRIPT macros to print boxes and page headings.

CONCLUSION

The Course Composition System has been used at the Institute since early 1986 for creating the structure of courses and for text entry and editing. System enhancements providing additional features, such as ability to capture output and screens, have been added in response to course developers’ requests. The IBM 3820 laser printer was installed in May of 1987, eliminating the necessity of typesetting the production versions of texts. Since that time, over twenty new courses have been developed, and many more have been revised. Courses that had never been produced in typeset form, due to time constraints, can now be produced with a typeset appearance on the 3820 printer. Course materials have fewer technical errors and are easier to revise and update. Programs appearing in course text can easily be tested on new versions of SAS software as they come into production. The creation of Instructor’s Guides and the movement toward indexes for all course texts would not have been feasible without the Course Composition System.

The future directions for the Course Composition System include the ability to accommodate wider varieties of course texts and styles of technical writing. Some discussion has been focused on development of a downloading process, so that much of the text development could be done in a PC environment. This feature would also allow a movement toward desk-top printing of the text for the development stage of the course.

The costs to be weighed against the many benefits from the system are essentially the costs of new equipment and system development time. The IBM 3820 printer and the PC scanner are both necessary to take full advantage of the capabilities of the system. An estimate of the time required to develop a similar system, assuming one developer working full-time on the project, would be about a year.

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