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A Conceptual Design for a Graphics Output Interface for the Worldwide Household Goods Information System for Transportation Modernization (WHIST-MOD)

J. Loftis
T. James

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Energy Division

A CONCEPTUAL DESIGN FOR A GRAPHICS OUTPUT INTERFACE FOR THE WORLDWIDE HOUSEHOLD GOODS INFORMATION SYSTEM FOR TRANSPORTATION MODERNIZATION (WHIST-MOD)

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ACRONYMS AND TERMS

COS	Code of Service
MTMC	Military Traffic Management Command
MTPP	Directorate of Personal Property, MTMC
ORACLE	Relational Database Management and related software
ORNL	Oak Ridge National Laboratory
QA	Quality Assurance
RDBMS	Relational Database Management System
SAS	Data Management and Statistical Analysis Toolset
WHIST-MOD	Worldwide Household Goods Information System for Transportation Modernization

ABSTRACT

The Directorate of Personal Property of the Military Traffic Management Command (MTMC) requested that Oak Ridge National Laboratory (ORNL) design and prototype a decision support system, the Worldwide Household Goods Information System for Transportation Modernization (WHIST-MOD). This decision support system will automate current tasks and provide analysis tools for evaluating the Personal Property Program, predicting impacts to the program, and planning modifications to the program to meet the evolving needs of military service members and the transportation industry. The system designed by ORNL consists of three application modules: system dictionary applications, data acquisition and administration applications, and user applications. The development of the user applications module is divided into two phases. Round 1 is the data selection front-end interface, and Round 2 is the output or back-end interface.

This report describes the conceptual design for the back-end output interface of the user applications module, which will be prototyped using SAS, a data management and statistical analysis toolset. This report discusses our goals for the back-end interface and describes how we plan to meet these goals. Our design fulfills the users' needs for a flexible interface that can be used to produce a variety of tabular and graphical output.

1. INTRODUCTION

1.1 BACKGROUND

The Worldwide Household Goods Information System for Transportation Modernization (WHIST-MOD) being designed and prototyped by Oak Ridge National Laboratory (ORNL) is a decision support system for the various organizations of the Military Traffic Management Command (MTMC) that establish and implement the Personal Property Movement and Storage Program. The decision support system will benefit the staff of the Personal Property Program in their tasks of program evaluation and policy setting. This system is designed to access a distributed database through a powerful set of information management tools.

The prototype system offers users, even those with minimal computer experience, easy access to a large selection of data elements and the ability to formulate complex queries. In addition, users may perform special studies and one-time-only *ad hoc* queries. WHIST-MOD will be a dynamic system that evolves to meet the changing needs of the Directorate of Personal Property MTMC (MTPP) staff.

User requirements for the WHIST-MOD system were identified during the analysis phase of the project. During this phase, ORNL identified three modules for prototyping to aid decision support activities at MTPP. These modules include applications to provide a description of components of the system (system dictionary applications), applications to manage data (data acquisition and administration applications), and applications to retrieve and display data from the database (user applications).

1.2 THE APPLICATIONS MODULE

The user applications module will be prototyped in two design and development phases. Round 1, the front-end interface, was prototyped using a relational database management system (RDBMS), ORACLE, and its associated toolset. The front-end interface includes screens that allow users to choose, retrieve, and store a subset of data. These data are then passed to the back-end interface.

Round 2 will prototype the back-end interface using SAS, a data management and statistical analysis toolset. The back-end interface will allow the user to specify report types and formats and to produce output based on the dataset passed to SAS from the front-end interface.

1.3 OVERVIEW

This report presents our concept for the design of the postprocessing back-end interface. Because it is a concept paper, it contains a high-level discussion of the goals of the interface and a theoretical approach for attaining these goals. ORNL has not been tasked with implementing the entire design, but rather with prototyping significant pieces that will serve as the basis from which MTPP staff will implement and expand the system. A description of the actual prototype of the concept will be contained in a separate document.

Section 1 introduces the report. Section 2 discusses the goals for the interface. Section 3 describes the SAS interface screens and pop-up windows designed to meet these goals. Section 4 gives examples of how the reports and charts required by the system could be produced by this interface.

2. GOALS FOR THE INTERFACE

We identified the goals for the back-end interface during the requirements analysis phase of the WHIST-MOD project. These goals are based on our analysis of current user needs and our vision of the current and future needs of the users and the system itself. The following is a list of goals for the back-end interface.

- The interface must be modular enough to support modifications and expansion.
- The interface must be generic enough to be used to produce a variety of reports.
- The interface must be easy to use.

The following sections discuss each of these goals.

2.1 MODULAR DESIGN

Because of the evolving nature of the personal property business, the interface must be designed to easily incorporate modifications and expansions. The need for modifications and expansions may come from a variety of sources. As MTPP staff monitor the Personal Property Program they will identify the need for changes and additions to the program. External sources such as Congress, the carrier industry, and service members may also create the need for changes in the program. For example, MTPP is currently in the process of consolidating separate quality assurance (QA) programs, international QA and domestic QA, into one standardized QA program. Once this new QA program is implemented, the WHIST-MOD system, including the back-end interface, will have to be modified to support this new program. Also, due to the changing needs of service members, MTPP recently expanded the definition of personal property to include privately owned pleasure boats. This change added a new category of personal property that needs to be supported by the system.

To remain useful, the system must be designed to easily accommodate these frequent and often unpredictable types of changes. In addition, the modular design of the back-end interface will be easier for programmers to understand than one long program and, therefore, less time-consuming to maintain.

The concept for the design of the back-end interface is modular. Each function is a separate entity. For example, there is one program to support the selection of an output type and a separate program to support the selection of data for a report. Another program will support the selection of variables that will be used to sort the output. Because these programs are designed as separate entities, it will be easy to add programs to support additional functions. For example, MTPP might require a program that provides regression options, such as confidence intervals, which can easily be added without significantly affecting existing functions. In addition, because functions exist as separate entities, it will be easy for the MTPP maintenance and modification staff to identify and locate specific programs where modifications are desired. For example, the current design for the output type selection program supports bar charts, line charts, tabular reports, and scatter plots. This program could easily be changed to support additional output types such as pie charts or three-dimensional charts.

2.2 GENERIC DESIGN

Another goal for the back-end interface design is that it be generic enough to be used to produce a variety of reports. The interface is designed to be generic on three levels to support the production of reports.

- It is designed to support the production of 12 report types.
- It is designed to support the production of four output types for each report type.
- It is designed to support the selection/manipulation of data for each output type.

2.2.1 Variety of Report Types

Staff at MTPP currently produce different reports based on their work division. There are three divisions of work at MTPP: QA and Operations, Rates, and Management Support. Some staff assigned to work in the QA and Operations Division monitor carrier performance. They often produce reports that identify carriers who miss delivery dates, carriers who have been disqualified from the Personal Property Program, or carriers who damage shipments in transit. Staff who work in the Rates Division monitor the changes in the carrier rates that were bid for moving and storing personal property. The staff who work in the Management Support Division monitor the overall program and produce reports for external agencies such as Congress and the Armed Services.

During the requirements analysis phase of WHIST-MOD, 12 report types that encompass the needs of these three work divisions were identified. For example, there is a Missed Required Delivery Date Report that is frequently produced by the QA and Operations staff. Rates staff need to produce a Change in Rate Levels Report. All three divisions produce a Number of Shipments Report and a Net Weight Shipped Report.

The prototype front-end interface completed by ORNL in March 1990 was designed to retrieve data for each of these 12 report types. The back-end interface must be designed to be generic enough to accept the data retrieved by the front-end and produce output for each of the 12 report types.

2.2.2 Variety of Output Types

For each of these report types the staff at MTPP may need, depending on the purpose, to produce different output types. They need bar charts, line charts, and scatter plots to represent trends in the Personal Property Program and tabular output to report detailed information. These output types may be used internally as an analysis tool or externally to provide information for other agencies. For example, if MTPP staff are analyzing trends in shipment weights for specific carriers, or if Congress requests shipment weight information, MTPP staff need the ability to quickly produce tabular or graphical reports.

The back-end interface is designed to be generic enough to support the production of tabular as well as a variety of graphical output for each report type. Our design for the back-end interface supports the production of the following output types:

- tabular reports,
- bar charts,
- line charts, and
- scatter plots.

A query in the front-end selects data from the appropriate database table based on the parameters the user chooses. Some of the data selected and the specific database tables used for the selection of data are dependent on the report type the user chooses. However, our concept is that these data will be stored in a single data file that will be used by the back-end, regardless of the report type the user wants to produce. This design is generic because it does not require multiple dataset files or different sets of back-end programs for each report type.

2.2.3 Selection/Manipulation of Data

For each report type, staff at MTPP need the ability to produce reports that display different data. For example, users may wish to produce a Net Weight Shipped Report that shows the weight shipped for specific carriers for a particular year. They may also need to produce the same report type that shows the weight shipped by particular codes of service for the same year.

Therefore, another goal of the design of the back-end interface is to provide the ability for users to select different data columns from the dataset file created in the front-end interface. The dataset file prototyped in our front-end interface is created from a query of the database and contains a prescribed set of data columns, depending on the report type the user has chosen to produce. From this set of data columns, we intend to provide the capability for the user to choose specific columns for a report type.

Not only do the users need to select data columns from the dataset file, they also need the ability to manipulate these data. For a tabular report the users need to choose data columns for sorting the output. For example, they may need the tabular output sorted by codes of service, or by carriers, or by one of the other data columns. They also need to perform different calculations on these data. They need to select the particular data column to use for the calculation, and they need to be able to specify the calculation type. For example, the user may want to calculate an average on the weight column for a Net Weight Shipped Report.

Our goal for the back-end interface is that it be generic enough to support interactive sorting and the interactive selection of calculation variables. It must also support the following calculation types:

- average,
- percent, and
- total.

2.3 EASE OF USE

MTPP staff also need an interface that is easy to use because there is a high rate of staff turnover and they have disparate computer skill levels. MTPP frequently has new employees and could lose experienced staff. And although some MTPP staff currently are experienced computer users, others have minimal computer experience. All MTPP staff must produce reports.

Another goal for the back-end interface design is to make it easy to use so that even inexperienced computer users can quickly and easily produce a variety of reports. The interface must be designed to protect the user from the sophistication and complexity of the application development software. Each screen should allow users to select and manipulate data by simply pressing a key, and extensive interactive help messages should be incorporated into the design of the interface.

3. SAS INTERFACE SCREENS

This section provides our concept for the types of screens we anticipate developing for the user interface. It provides a generalized overview only. More detail will be incorporated into this design as the screens are developed. The following sections discuss our initial design for the SAS interface screens which consist of the Output Selection Screen and five pop-up window screens.

The Output Selection Screen (Fig. 3.1) will be the primary screen for making choices for the output. This screen will be divided into three sections:

- the Output Type Section,
- the Customization Options Section, and
- the Directing and Previewing Output Section.

The Customization Options Section calls the pop-up window screens. The bottom portion of the Output Selection Screen will contain a line that displays dynamic help messages. These messages will change as the user moves through the three sections.

3.1 OUTPUT TYPE SELECTION SECTION

The Output Type Section of the Output Selection Screen will allow users to choose whether they want a tabular report, a bar chart, a line chart, or a scatter plot. After the user makes a selection, the cursor will move to the second section on the screen.

3.2 CUSTOMIZATION OPTIONS SECTION

The Customization Options Section will be a menu from which the user may choose to perform a variety of data selection/manipulation tasks. The following options will be offered in this section:

- data selection,
- sort,
- calculation,
- label, and
- other options.

When users choose an option in this section, a pop-up window will appear. The window will display the choices available for that option. Sections 3.2.1 - 3.2.5 discuss the pop-up windows that will be called from the Customization Options Section.

3.2.1 The Data Selection Pop-up Window

The Data Selection Pop-up Window will display all the data columns that are available for the report type (Sect. 2.2.1). Users may choose the data they want to include in the chart or report (Fig. 3.2). The data columns are contained in the SAS data file and are based on choices the user made in the ORACLE front-end. For more information on

ORNL-DWG 90-14204

Output Selection

Output Type Section

* Tabular Report
__ Bar Chart
__ Line Chart
__ Scatter Plot

Customization Options Section

__ Data Selection
__ Sort
__ Calculation
__ Label
__ Other Options

Direct and Preview Output Section

__ Preview
__ Direct
__ Go

Move cursor up and down and press RETURN to select report type.

Fig. 3.1. The Output Selection Screen.

ORNL-DWG 90-14205

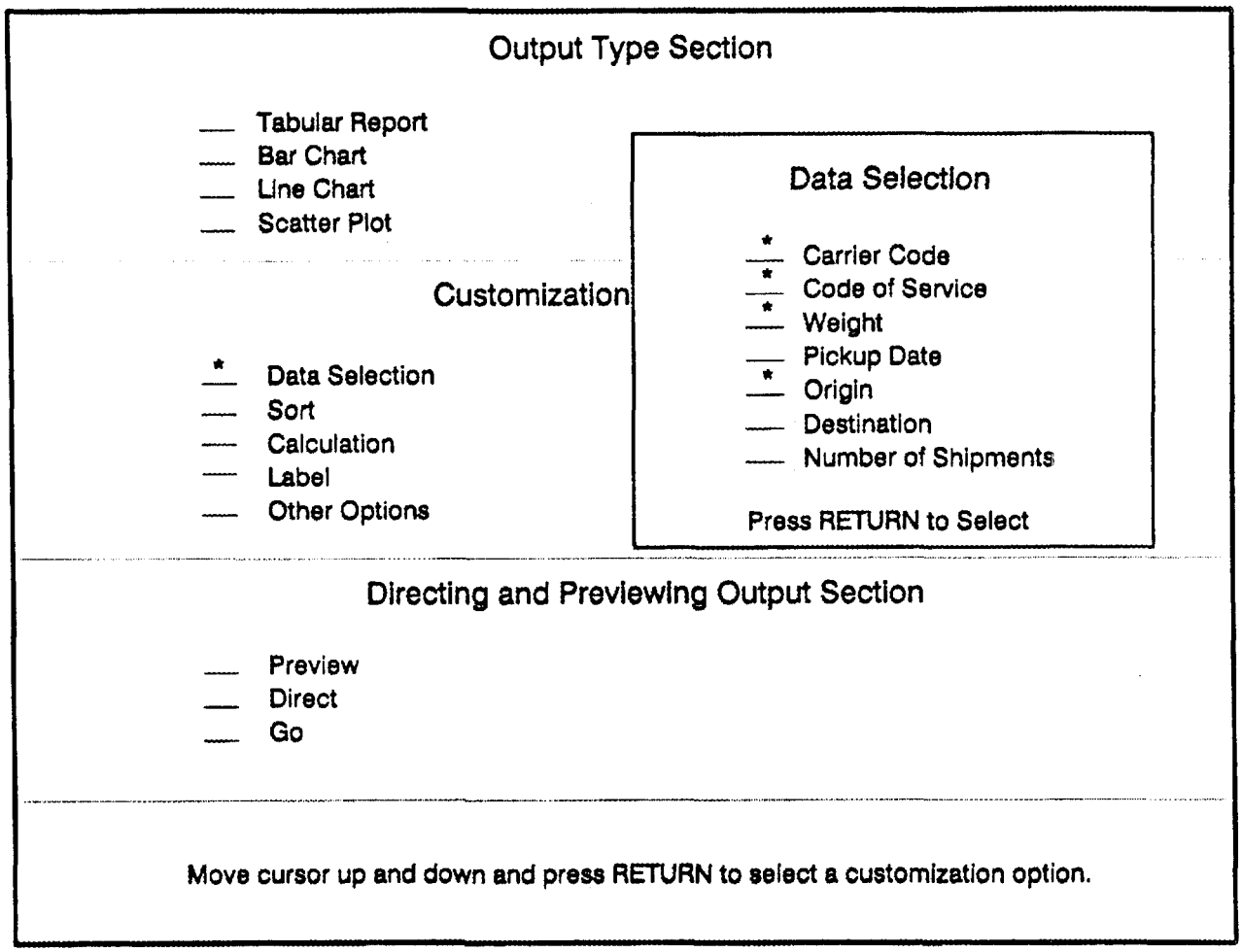

Fig. 3.2. The Output Selection Screen with the Data Selection Window.

the creation of the dataset file see *User Interface in ORACLE for the Worldwide Household Goods Information System for Transportation Modernization (WHIST-MOD).*[*]

3.2.2 The Sort Pop-up Window

The Sort Pop-up Window (Fig. 3.3) will allow the user to sort by one or more data columns. The columns that appear in this window will be limited to those columns chosen in the Data Selection Window. For example, if the user chooses carrier code, code of service, weight, and origin in the Data Selection Pop-up Window, only those columns will appear in the Sort Window.

3.2.3 The Calculation Pop-up Window

The Calculation Pop-up Window wil allow the user to select a type of arithmetic operation and columns on which to perform this operation. The arithmetic operation options include the following:

- average,
- percent,
- total, and
- subtotal.

The data columns used in the calculation will be any numeric columns the user selected in the Data Selection Window. In Fig. 3.2, for example, weight and number of shipments are the only numeric data columns; therefore, the user could choose to average, total, subtotal, or calculate a percentage on the weight column or the number of shipments column.

3.2.4 The Label Pop-up Window

The Label Pop-up Window will allow users to specify screen text for their report or chart. The text may consist of one or more of the following, depending on whether the output is a tabular report or a chart:

- titles and subtitles,
- column headings,
- x and y axis labels,
- legends, and
- other labels.

---

[*]T. James and J. Loftis, *User Interface in ORACLE for the Worldwide Household Goods Information System Modernization (WHIST-MOD)*, ORNL/TM-11596, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, August 1990.

ORNL-DWG 90-14206

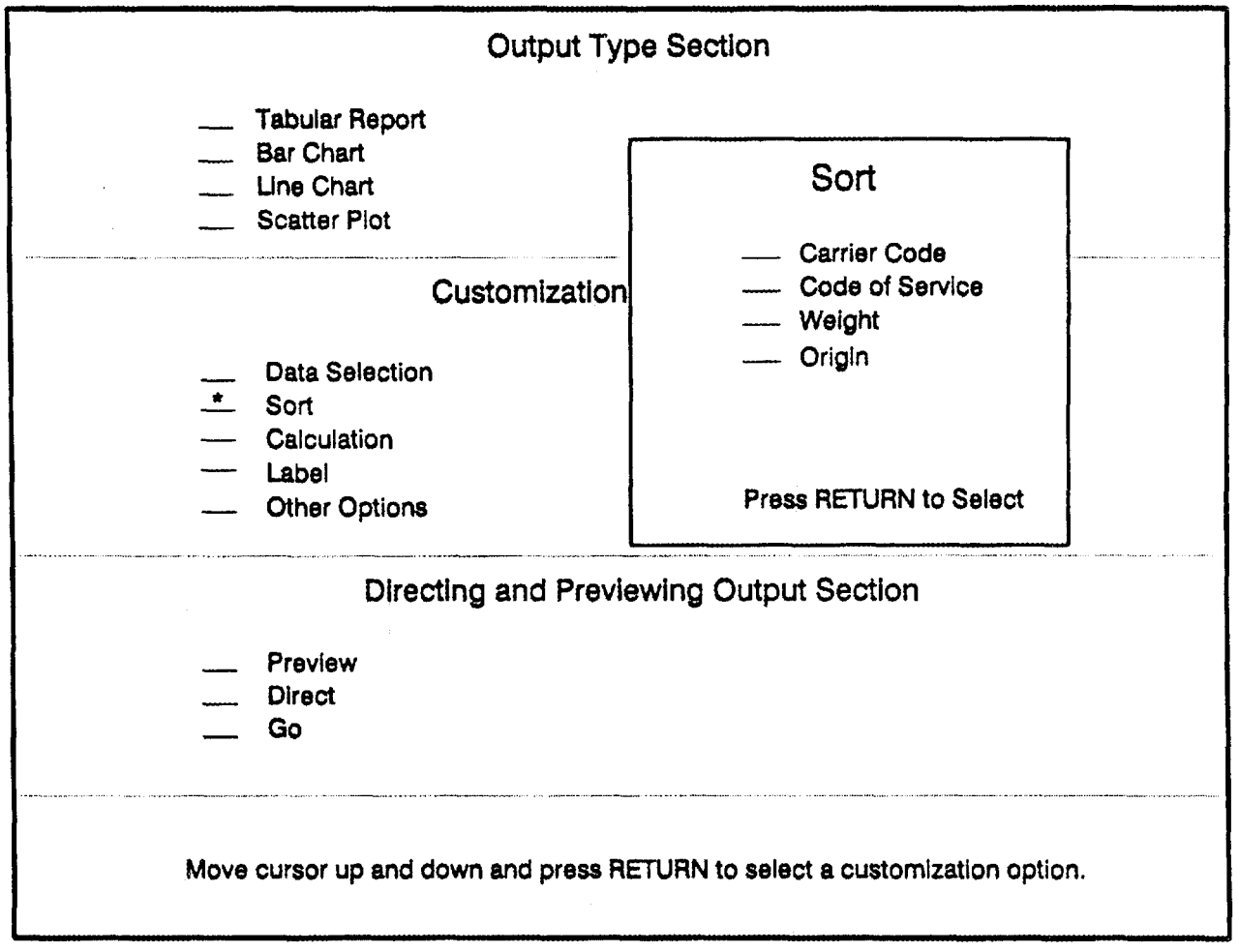

Fig. 3.3. The Output Selection Screen with the Sort Window.

3.2.5 The Other Options Pop-up Window

The selections available in the Other Options Pop-up Window will vary depending on whether the user chose to produce a report, chart, or plot. The Other Options Window will allow the user to specify the following:

- line type,
- fill type,
- colors,
- borders,
- scale/range,
- fonts,
- lines per page, and
- length of line.

3.3 DIRECTING AND PREVIEWING OUTPUT

After users have chosen an output type and the desired options in the Customization Options Section, they will move to the Directing and Previewing Output Section. This section will allow users to review their output and/or to choose the output destination for their report, chart, or plot.

3.3.1 The Preview Pop-up Window

The Preview Pop-up Window will display the output on the screen before it is sent to a printer, plotter, or file. If the output is satisfactory, the user may move to the next category and direct the output to a device or a file (see Sect. 3.3.2). Otherwise, he or she may go back to the Customization Section of the Output Selection Screen to modify selections.

3.3.2 Direct Output

The Direct Output Window will allow the user to direct output to the following:

- a printer,
- a plotter, or
- a file.

3.3.3 Go

The Go Window will send the output to the destination specified by the user in the Direct Output Window. The users will make this selection when they are ready to print their output.

4. EXAMPLES OF OUTPUT PRODUCED BY THE INTERFACE

This section gives examples of how users could use the SAS interface screens to produce a variety of output types for a report. From the 12 report types, we have chosen Weight Shipped as the report we use in the examples. Many different reports could be produced for Weight Shipped by varying the options and data columns selected in the interface screens and windows. The following sections give only a few simple examples to illustrate the basic flexibility of our design.

4.1 TABULAR REPORTS

This section discusses the steps a user would take to produce specific tabular reports. For all of these reports, the user will select the Tabular Report option in the Output Type Section of the Output Selection Screen. The following data columns for the Weight Shipped Report will appear on the Data Selection Screen:

- carrier code,
- number of shipments,
- code of service,
- weight,
- pickup date,
- origin, and
- destination.

4.1.1 Example Report 1

This sample report assumes the user wants to produce a report showing the average weight of shipments by month that arrived in California in 1989. To create the report shown in Fig. 4.1, the user will choose the pickup date column and the weight column from the Data Selection Window.

ORNL-DWG 90-14212

Average Weight Shipped
into California in 1989

Pickup Month	Average Weight Shipped
January	2,400
February	3,000
March	3,200
April	2,000
May	5,000
.	.
.	.
.	.

Fig. 4.1. Example Report 1.

In the Sort Window, the user will choose to sort pickup date by month. In the Calculation Window, the user will choose to average the weight column. In the Label Window, the user will enter the following:

Title: Average Weight Shipped
Subtitle: Into California in 1989
Column 1: Pickup Month
Column 2: Average Weight Shipped

4.1.2 Example Report 2

This sample report assumes the user wants to produce a report showing average weight shipped by carriers. To create the report shown in Fig. 4.2, the user will choose the carrier code column and the weight column from the Data Selection Window. In the Sort Window, the user will choose to sort by carrier codes. In the Calculation Window, the user will choose to average by the weight column. In the Label Window, the user would enter the following:

Title: Average Weight Shipped by Carrier
Subtitle: (not included in this report)
Column 1: Carrier Code
Column 2: Average Weight Shipped

ORNL-DWG 90-14213

Average Weight Shipped by Carrier

Carrier Code	Average Weight Shipped
ABCD	7,000
BCDE	2,500
CDEF	4,000
.	.
.	.
.	.

Fig. 4.2. Example Report 2.

4.1.3 Example Report 3

This sample report assumes the user wants to produce a report showing the number and average weight of shipments into California in 1989, by code of service. It includes the total number of shipments and the overall average weight of a shipment. To create the report shown in Fig. 4.3, the user will choose the code of service, number of shipments, and weight columns from the Data Selection Window. In the Sort Window, the user will choose to sort by code of service.

ORNL-DWG 90-14214

Average Weight Shipped into California in 1989

Code of Service	Number of Shipments	Weight
1A	200	2,000
1B	300	4,000
2A	100	2,500
2B	93	1,900

Total Number of Shipments: 693
Average Weight of a Shipment: 2,600 lbs

Fig. 4.3. Example Report 3.

In the Calculation Window, the user will choose to average on the weight column, to subtotal by code of service on the number of shipments column, and to total on the number of shipments column. In the Label Window, the user would enter the following:

Title:	Average Weight Shipped
Subtitle:	into California in 1989
Column 1:	Code of Service
Column 2:	Number of Shipments
Column 3:	Weight

4.2 GRAPHICS

This section discusses the steps a user would take to produce specific graphical reports. The user will choose either Bar Chart, Line Chart, or Scatter Plot in the Output Type Section. For all these graphical output types, the following choices, which are the columns for the Weight Shipped Report, will appear on the Data Selection Window:

- carrier code,
- number of shipments,
- code of service,
- weight,
- pickup date,
- origin, and
- destination.

4.2.1 Bar Chart Example

This sample report assumes the user wants to produce a bar chart showing average weight shipped for 1986 sorted by code of service and by carrier.

To create the report shown in Fig. 4.4, the user will choose Bar Chart in the Output Type Section. Then, from the list of available columns in the Data Selection Window, the user will choose:

- weight,
- code of service, and
- carrier code.

In the Sort Window, the user will select carrier code for the primary sort and code of service for the secondary sort. In the Calculation Window, the user will choose to average on the weight column. In the Label Window, the user would enter the following:

Title:	Average Shipment Weight for 1986
y axis:	Average Weight

ORNL-DWG 90-14207

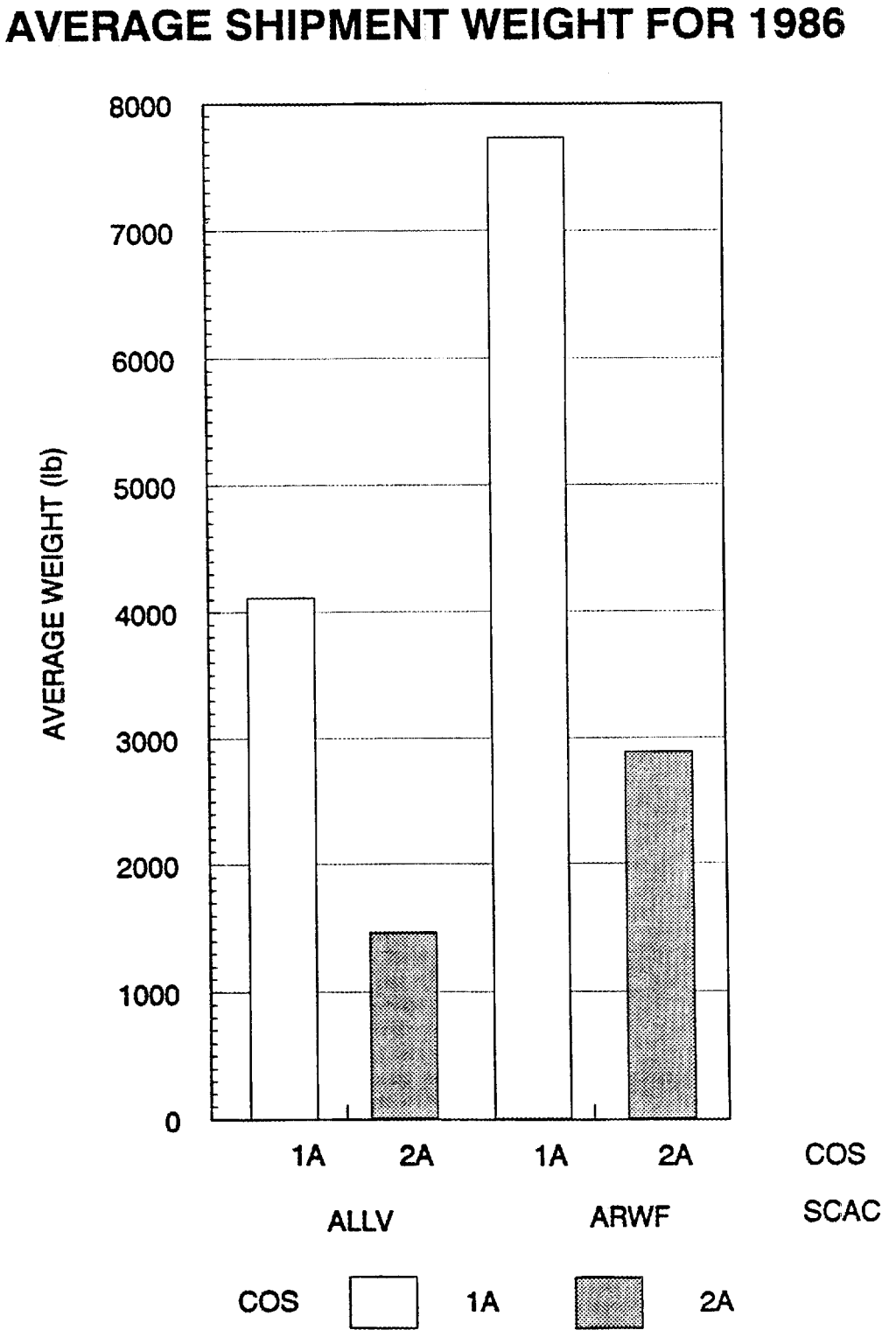

Fig. 4.4. Example of a bar chart.

4.2.2 Line Chart Example

This sample report assumes the user wants to produce a line chart to show the average weight shipped from specific states during a calendar year. To create the line chart shown in Fig. 4.5, the user will choose Line Chart in the Output Type Section. Then, from the list of available columns in the Data Selection Window, the user will choose

- weight,
- pickup date, and
- origin.

In the Sort Window, the user will select origin for the primary sort and the pickup date (by month) for the secondary sort.

In the Calculation Window, the user will choose to average on the weight column. In the Label Window, the user will enter the following:

Title:	Average Shipment Weight by Origin States
x axis:	Month
y axis:	Average Weight
Legend 1:	VA
Legend 2:	MD
Legend 3:	DC

ORNL-DWG 90-14208

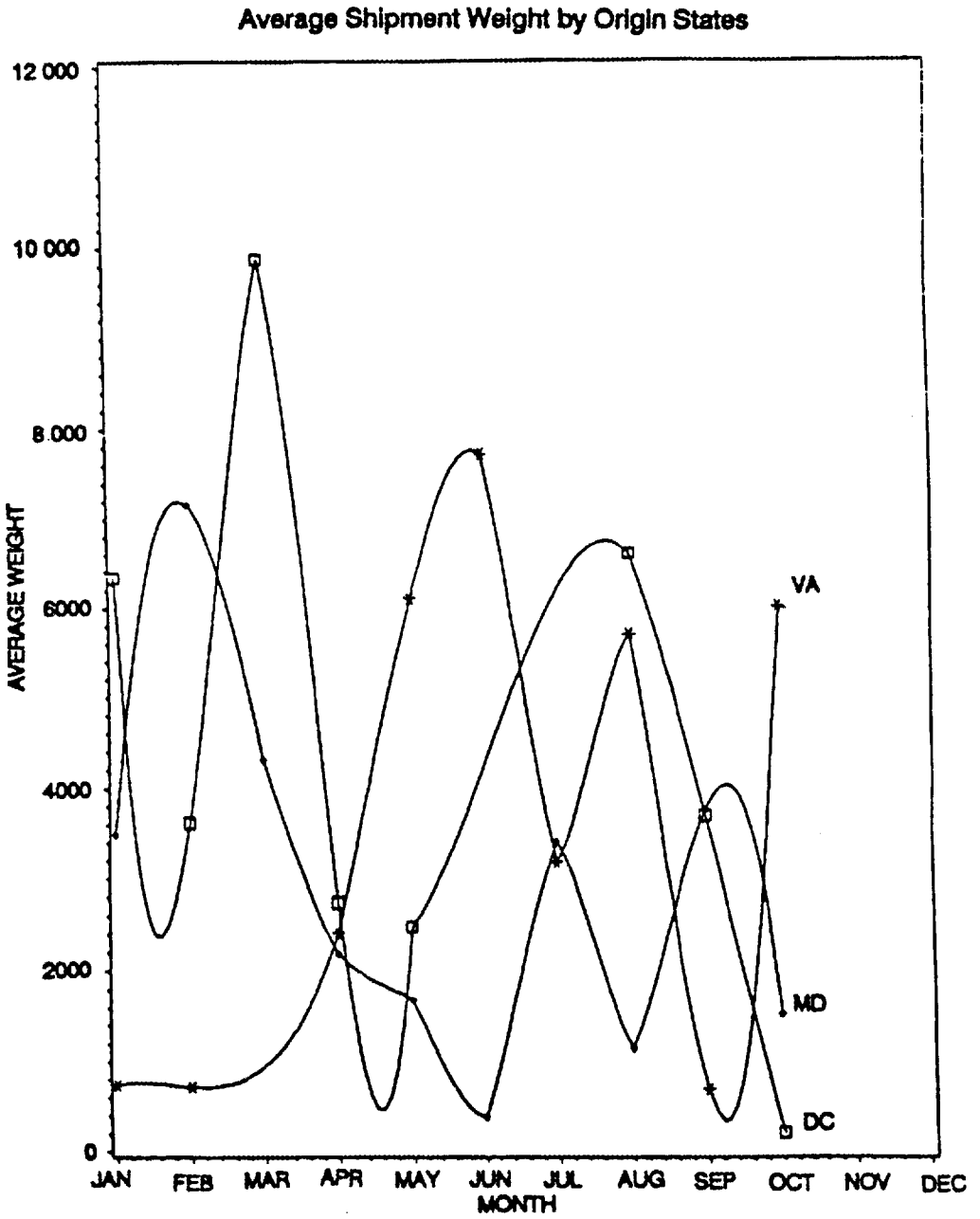

Fig. 4.5. Example of a line chart.

5. SUMMARY

The staff at MTPP are responsible for monitoring almost one million shipments annually. On the basis of the shipment data, they must evaluate the Personal Property Program and investigate the effects of policy changes. Currently, MTPP staff spend the majority of their time manually gathering, organizing, checking, and distributing data; supplying information to other federal agencies; and interacting with carriers concerning data problems. They have little time to analyze data that identify trends, predict impacts of trends and other changes on the Personal Property Program, or to recommend policy changes based on their analysis of the program.

The user applications module designed and prototyped for WHIST-MOD will automate many of the tasks now performed manually by MTPP staff. This automation will allow the staff to spend more time analyzing the Personal Property Program. In addition, the front- and back-end interfaces will allow the user quick access to data and the ability to manipulate and display these data easily. This document describes our design for a flexible back-end interface.

We conclude that this design of the postprocessing back-end interface for WHIST-MOD will support the reporting needs of the staff at MTPP. The design is flexible and generic enough to allow MTPP staff to produce a variety of report types and output types. It is modular enough to allow for easy expansion and modification of the interfaces, and it will be easy to use. Therefore, this design will be used by ORNL to prototype the back-end interface.

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