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Airlift Deployment Analysis System (ADANS) Development Guidelines: User Interface

L. F. Truett
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S. S. Stevens

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ENERGY DIVISION

AIRLIFT DEPLOYMENT ANALYSIS SYSTEM (ADANS) DEVELOPMENT GUIDELINES: USER INTERFACE

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TABLE OF CONTENTS

ABSTRACT v
1. INTRODUCTION 1
1.1 BACKGROUND 1
1.2 ADANS ENVIRONMENT 1
1.2.1 Hardware 1
1.2.2 Software 2
1.2.3 Telecommunications 2
1.3 SCOPE OF THIS REPORT 3
1.4 REFERENCES 4
2. GENERAL GUIDELINES 5
2.1 INTRODUCTION 5
2.2 OVERALL SCREEN APPEARANCE 5
2.2.1 Classification Notification 6
2.2.2 Date and Time Notification 6
2.2.3 Status 7
2.3 KEYBOARD AND MOUSE 8
2.4 SYSTEM MESSAGES 8
2.5 PRINT FUNCTION 9
3. ADANS "LOOK AND FEEL" GUIDELINES 11
3.1 INTRODUCTION 11
3.2 THE ALPHANUMERIC WINDOW 11
3.2.1 Levels of Menus 12
3.2.2 Menu Appearance and Functionality 12
3.2.3 Exiting the Alphanumeric Window 12
3.3 THE MAP GRAPHICS WINDOW 13
3.3.1 The Default Map Display 13
3.3.2 MAC-Specific, Map-Based Data 15
3.3.3 Selection of Data in Context 15
3.4 THE TIME-CHART GRAPHICS WINDOW 15
3.4.1 Levels of Time Interval Detail 16
3.4.2 Region or Station Selection 16

3.4.3 Mission and Resource Details 16
3.5 CONTEXT SENSITIVITY AND RELEVANT DISPLAYS 17
4. ADANS APPLICATIONS DESIGN GUIDELINES 19
4.1 INTRODUCTION 19
4.2 THE APT FORMS 19
4.2.1 The APT Menus 21
4.2.2 The APT Data Portion 22
4.3 OTHER APT FORM FUNCTIONS 25
4.3.1 Form Identification 25
4.3.2 The "Working" Message 25
4.3.3 The "Caution" or Warning Message 26
4.3.4 Data Validation 26
4.3.5 Error Messages 26
4.3.6 Use of Units of Measure 27
4.4 HELP 27
4.5 APT RESERVED KEYS AND ICONS 28
4.6 APPLICATION PROGRAMMABLE FUNCTION KEYS 29
4.7 CONSTRAINTS 30
5. SUMMARY AND RECOMMENDATIONS 31
APPENDIX A 35
APPENDIX B 37

1. INTRODUCTION

1.1 BACKGROUND

Oak Ridge National Laboratory (ORNL) is the integrating contractor for the Airlift Deployment Analysis System (ADANS) for the U.S. Air Force. ADANS is an automated system that will provide Headquarters Military Airlift Command (HQ MAC) and the Numbered Air Forces (NAFs) with planning, scheduling, and analytical tools for peacetime, deliberate, and execution planning. ADANS supports a wide variety of functions and communicates complex information with temporal and spatial interrelationships.

ORNL has been working on the ADANS project since September 1986. To date, ORNL has been conducting system requirements analyses and capturing design details for the system's target platform, as well as establishing a prototyping development methodology. ADANS is being prototyped in three increments in order to provide an initial operating capability as quickly as possible. The project is currently in Revised Increment I. At the end of Revised Increment I, and each subsequent increment, an operational portion of the system will be installed. The complete system will be delivered at the end of the third increment. ADANS will be completed by October 1992.

1.2 ADANS ENVIRONMENT

1.2.1 Hardware

ADANS resides on two networks of SUN 4 workstations, one for classified and one for unclassified data (see Sect. 2.2.1). ADANS users have access to a keyboard and a mouse for data entry and selection of functions or fields. In addition, the SUN monitor provides high-resolution color displays.

Laser, dot matrix, and high-speed line printers will provide reports from ADANS. Formal printed reports can be produced by selecting specific menu options. In addition, modified screen dumps are possible. If a user is in an application window (see Sect. 1.2.2) and requests a screen print, the contents of the data portion of the window in which the cursor is located are printed; however, the

entire screen is not printed. If a user is in a non-application window (e.g., a graphics display window), the screen dump may not be possible. It has not yet been determined whether software will be available to permit this capability.

1.2.2 Software[1]

ADANS contains a massive amount of data, which is manipulated through Sybase, a relational database management system (DBMS). The Sybase Application Productivity Tool (APT) is used for the development of application windows, and Ada is used to produce graphics and any necessary procedural code. (The C programming language is used as an interim language for prototyping until Ada is available for use by developers.) The scheduling algorithms are currently written in FORTRAN. Interfaces among different software are transparent to the ADANS user.

1.2.3 Telecommunications

Data from other computer systems received electronically by ADANS will be processed by system communications programs and placed into designated directories as formatted American Standard Code for Information Interchange (ASCII) files. Current understanding of the Global Decision Support System (GDSS) interface, with which ADANS will communicate, is that the "MAIL" capability of the SUN software will be utilized. Application programs written by ADANS functional developers (invoked as menu choices by ADANS users) will read the files, verify the information, and store the data in appropriate tables within the ADANS database.

Information to be sent electronically from ADANS to other systems will be compiled, formatted, and stored as ASCII files by similar application programs written by ADANS functional developers. A menu-based "mail"-like application program, to be written as part of the system administration functions, will allow ADANS users to send the information to defined valid addresses.

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[1]Sybase is a registered trademark of Sybase, Inc., Berkeley, CA; Ada is a registered trademark of the United States Department of Defense, Ada Joint Program Office; C is a registered trademark of Bell Laboratory, Piscataway, NJ; and Fortran is a registered trademark of IBM, Armonk, NY.

1.3 SCOPE OF THIS REPORT

This user interface document is the first in a series of development guidelines for the Airlift Deployment Analysis System (ADANS) project. Additional reports will include, at least, programmers' guidelines (Vol. 2) and on-line help specifications (Vol. 3).

This report documents the user interface design as it currently exists. These guidelines, which are specific to the current ADANS operating environment, will be used by the developers of ADANS to create a consistent, efficient, and logical user interface. A good user interface optimizes the interactions between a computer system and the personnel using the system and minimizes conditions that degrade human performance or cause human error. ADANS is still under development; as new capabilities become available to the ADANS development team, the ADANS user interface will be modified. Thus, a revision of this report is expected.

Throughout this report, the word "user" refers to the end user of ADANS (i.e., personnel at HQ MAC and the NAFs). The term "developer" refers to ORNL personnel or ORNL contractors who are developing the ADANS programming software. The term "screen" always means the entire SUN monitor, while the term "window" refers to any of the windows that have been opened on the screen. For example, maps, navigation menus, time charts, and applications written in Sybase APT appear in different windows.

Although ADANS does not currently exist as a final operational system, the verbs throughout this report are in the present tense to prevent confusing switches between what currently exists and what will exist in the near future.

Section 2 contains general guidelines and addresses standards that are contained in ESD-TR-86-278 (1986), MIL-STD-1472C (1981), and WIS-STD-010 (1988) (see Sect. 1.4). Section 3 discusses the ADANS user interface as it relates to the developers of the ADANS "look and feel." Section 4 contains user interface guidelines for the developers of specific ADANS applications. Section 5 summarizes the ADANS user interface design, lists areas that should be addressed in the future, and examines issues that should be resolved before the user interface design is complete.

Helpful hints and programmers' notes are included but set off from the text. They are presented in smaller font and centered between bars.

1.4 REFERENCES

Smith, S.L., and Mosier, J.M., Guidelines for Designing User Interface Software, ESD-TR-86-278, MITRE Corporation for the U.S. Air Force Systems Command, 1986.

User-Computer Interface, MIL-STD-1472C, SECT.5 Military Standard, Human Engineering Design Criteria for Military Systems, Equipment and Facilities, 1981.

Worldwide Military Command and Control System (WWMCCS) Information System (WIS), U.S. Air Force Systems Command Technical Report, WIS-STD-010, Human Factors Engineering Standards, 1988.

2. GENERAL GUIDELINES

2.1 INTRODUCTION

ADANS is an interactive system capable of supporting multiple SUN workstations. The user interface supplies the following:

a. access to the algorithm, database, and other tools necessary for developing a mission schedule;

b. ability to review and edit schedules and statuses;

c. error checking; and

d. ability to print reports and to transmit schedules.

ADANS exists in SunView, a windowing-icon-mouse-pointing environment. ADANS communicates with the user through both graphics and standard English. Graphics displays appear in windows upon request. A complete description of the categories of windows used in ADANS appears in Sect. 3.

2.2 OVERALL SCREEN APPEARANCE

On the ADANS screen (i.e., the SUN monitor), movement generally progresses from left to right and from top to bottom. All graphics and text appear in windows. In the applications window (see Sect. 4), movement between fields is in a logical order that is familiar to the ADANS users.

Certain features are required for the applications windows. For example, each application form has an identification code (labeled the "menu title" in Sybase APT), and for each application that has multiple, consecutive pages, sequence indicators are present ("page x of y" notation). These characteristics are explained more fully in Sect. 4.

The SUN screen has more than 200 color hues available. Colors to be used for screen background, foreground, and graphics windows are yet to be determined. The use of background color in application windows is described in Sect. 4. In consideration of color-blind users, low-saturation hues of reds and greens are not used.

The following items must appear on every ADANS screen: classification, date and time, and status of the user within ADANS.

2.2.1 Classification Notification

ADANS operates in both a classified and an unclassified environment; however, the two environments are completely separate. That is, a SUN workstation that performs classified functions will never be used to access the unclassified database or to perform unclassified functions. Similarly, SUN workstations that perform unclassified work will never access the classified database and will never conduct classified business.

To fulfill the requirement to display the work classification on the computer screen, the following conventions are followed:

a. All ADANS workstations that perform classified work display the word "CLASSIFIED" in upper case centered in windows at the top and bottom of every screen; in addition, a print driver prints the word "CLASSIFIED" at the top and bottom on every piece of paper printed from the ADANS classified area.

b. All ADANS workstations that perform unclassified work display the word "UNCLASSIFIED" in windows at the top and bottom of every screen.

2.2.2 Date and Time Notification

The date and time automatically appear in the upper right-hand corner of the same window containing the classification information. The date and time are displayed in a military format using Zulu time and are updated by the minute.

2.2.3 Status

Using the record-of-menu progression, the user will always know precisely where he/she is in ADANS at any time. The recent history of a user's menu selections will be contained in a file. The history will be displayed as the contents of a scrollable window, with successive menu choices shown separated by '/' (or another suitable delimiting character). The location and status of the history window are among the customizable aspects of the user's environment; default location will be the upper left section of the screen, and default status will be "displayed," with the ability to reduce the display to an icon.

In addition to this default window showing a record-of-menu progression, the users have other means of checking their status. If the user is in an application, the title of the application appears in the menu bar of the application (see Sect. 4). Throughout ADANS, the field in which the cursor resides is highlighted using reverse video. In addition, the cursor position is indicated through standard video display (i.e., reversed from the reversed field display). The cursor does not obscure any character contained in the position occupied by the cursor.

When a new menu or application is accessed, the home position for the cursor is at the top left or at the first data input field, respectively. All menus have wrap features between the beginning and ending menu entries; therefore, the user can move from the bottom entry to the top entry in one key stroke.

If any "standard" variables change (e.g., the usual function of a function key), the display will alert the user to the change for as long as it is in effect. Notification of temporary changes appear at the bottom of the screen if they are in effect globally and at the bottom of a window when they are window specific.

When the user wishes to exit ADANS, one of two explicit commands is required: the command "EXIT" exits ADANS and saves all changes that have been made to the database; the command "CANCEL" exits ADANS and cancels the current process.

System administrators have access to additional system information, such as current users, current load, and equipment. Other information available to the system or data administrator includes information on data, files, functions, input, output, and sequential control.

2.3 KEYBOARD AND MOUSE

Nine programmable function keys are available on the SUN keyboard; however, no functions are currently programmed for use with the function keys. Some of the 15 "reserved keys" on the SUN workstations will be used for pre-programmed functions. In addition, Sybase APT uses combinations of keys (e.g., combining the "control" key with the letter "v") for function calls (see Sect. 4.5).

Although the "tab" key can be used to move within Sybase applications, the mouse will be the most common means of moving the cursor. Within applications, clicking the left mouse button selects the option on which the cursor rests. The right and center mouse buttons are not used within Sybase applications. Outside of Sybase, any of the three mouse buttons can be used to navigate through ADANS; however, there is no distinction in functionality between the left, the right, or middle button.

2.4 SYSTEM MESSAGES

Terminology in ADANS is consistent among the various on-line messages and within the system documentation. Messages are always phrased in user-familiar terminology, never in programmer language.

Users receive system messages when the system requires the user to stand by, the system needs to alert the user to a problem or potential problem, the system needs to receive confirmation for a requested action, or the user requests help or other information.

ADANS is a responsive system. If ADANS is unable to meet the maximum response time of 5 seconds, then a "Working..." message must be displayed (see Sect. 4.3.2).

As part of the ADANS security system, the system administrator receives a message if an unknown user attempts to log on to the system.

Errors, warnings, and other advisory messages are stated in clear, concise, standard English. Throughout ADANS, messages requiring a response from the user appear in the current active window. (For a discussion of advisory messages within Sybase applications, see Sects. 4.3.3 and 4.3.5). At any point during a transaction, the system can provide guidance on how to continue and/or exit.

On-line Help is available to the user upon request at every stage of system interaction and is in clear, concise English (see Sect. 4.4). Although Help is a support function within the user interface, its final design and implementation details are not currently available. Information will be published at a later date in a development guidelines document entitled "ADANS On-line Help Specifications."

2.5 PRINT FUNCTION

The primary print function for ADANS allows users to print predefined forms and reports (see also Sect. 1.2.1). ADANS produces ad hoc reports to support analytical and administrative functions. If the work is classified, the word "CLASSIFIED" is automatically added to the top and bottom of the printed page by the print driver.

3. ADANS "LOOK AND FEEL" GUIDELINES

3.1 INTRODUCTION

This section describes the "look and feel" (L&F) the ADANS software will present to its users. During normal operations, the ADANS software presents an enormous amount of information. When the techniques used to present this information are the best possible, the software will be most useful. This section uses the phrase "look and feel" to refer to techniques of access and presentation.

Because the ADANS database contains more information than can be easily assimilated at one time, it is essential to present only as much information to users as needed and desired. Therefore, the L&F emphasizes "layers" or "levels" of information to allow the user to select the degree of detail needed.

In addition to a large quantity of information, ADANS contains several different kinds of information. The L&F allows the user to select from three principal types of display: alphanumeric, map-graphic, and time-graphic. These displays are presented on the large-screen, multi-window SUN workstation so that a user can choose the most effective way(s) to display relevant details about MAC airlift resources and requirements.

3.2 THE ALPHANUMERIC WINDOW

When a user logs onto an ADANS workstation, the initial software access is the ADANS shell program, and the active display at the log-in entry point is the alphanumeric window. From an initial menu, the user specifies the type of processing to be performed, repeatedly narrowing the choice until reaching an alphanumeric function that has been implemented as either a DBMS application or a procedural-language program. The ADANS shell program then runs the DBMS application or Ada program in the alphanumeric window. Users interact with this alphanumeric window in the manner of most data entry/display (non-graphic) computer systems, using keyed instructions, data, and queries to access text and numbers. Application programs that are Sybase applications without procedural-language extensions need no modifications or special extensions to

run from the ADANS shell. Special arrangements will be made to manage Sybase applications that call procedural-language routines.

3.2.1 Levels of Menus

At log-in, the user sees the highest level of relevant menu options, as determined by access-permission entries in a table maintained for that purpose. For example, users authorized to do only Channels planning see only Channels functions on their menus; they can then navigate through those choices to a specific Channels data entry/display screen. A user who works in several areas sees, in addition to a top-level Channels choice, additional menu options (e.g., Pre-Planning and Planning functions). Preliminary estimates indicate a menu hierarchy no deeper than five or six levels.

3.2.2 Menu Appearance and Functionality

Presentation and function of menus follow user interface standards as specified in the references listed in Sect. 1.4. The text for menu choices and the actual program names for the functions called are stored in tables maintained within software designed under contract with Computer Aided Planning and Scheduling (CAPS).[2] Consequently, the menu system is isolated from changes in ADANS as it evolves. Current ideas about good interface design suggest that system builders limit the number of menu choices at a given level to about seven.

3.2.3 Exiting the Alphanumeric Window

When users exit the highest level menu to which they have access, they are also logged out of ADANS. Users with sufficient access privileges will be able to perform other functions concurrently with, or instead of, running the ADANS shell, but many users will also log out of the ADANS access software when they leave the ADANS shell.

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[2]CAPS, Atlanta, Georgia.

3.3 THE MAP GRAPHICS WINDOW

To augment the information available in the alphanumeric window, an ADANS user is able to invoke concurrently another window containing map-based graphical depictions of data from the ADANS Sybase database. Within this window, a user sees a map with enough detail for clear geographical orientation. Also, within the window there is a subset of the ADANS entities and attributes that have been retrieved by the application currently running in the alphanumeric window. A sample of a simple map display appears in Fig. 3.1 to illustrate some of these concepts.

Sybase application developers should be prepared to indicate to the CAPS Technical Project Officer those entities from the Sybase database they wish to have displayed on maps.

Although the user has considerable freedom to choose the data to be displayed within each graphical window, the default level of detail is uncluttered and matches the appropriate amount of graphical detail with associated alphanumeric detail.

3.3.1 The Default Map Display

The default contents of map displays will be determined based on consultation with expert users and application developers. These default displays can be tailored by users to their specific needs. Decisions to be made regarding map display capabilities include the following:

a. the number and extent of precomputed maps of portions of the world,

b. the kind and amount of geographic detail to be included for orientation, and

c. the MAC-specific details to be displayed unless explicitly omitted.

For example, a subset map might include eastern United States, western Europe, and enough of the north polar area and the North Atlantic to show flight paths. National political boundaries and major bodies of water might be shown in outline. Major air stations in the area can be shown symbolically. To the extent feasible, the published guidelines listed in Sect. 1.4 have been followed in the development of these ADANS guidelines for graphics displays.

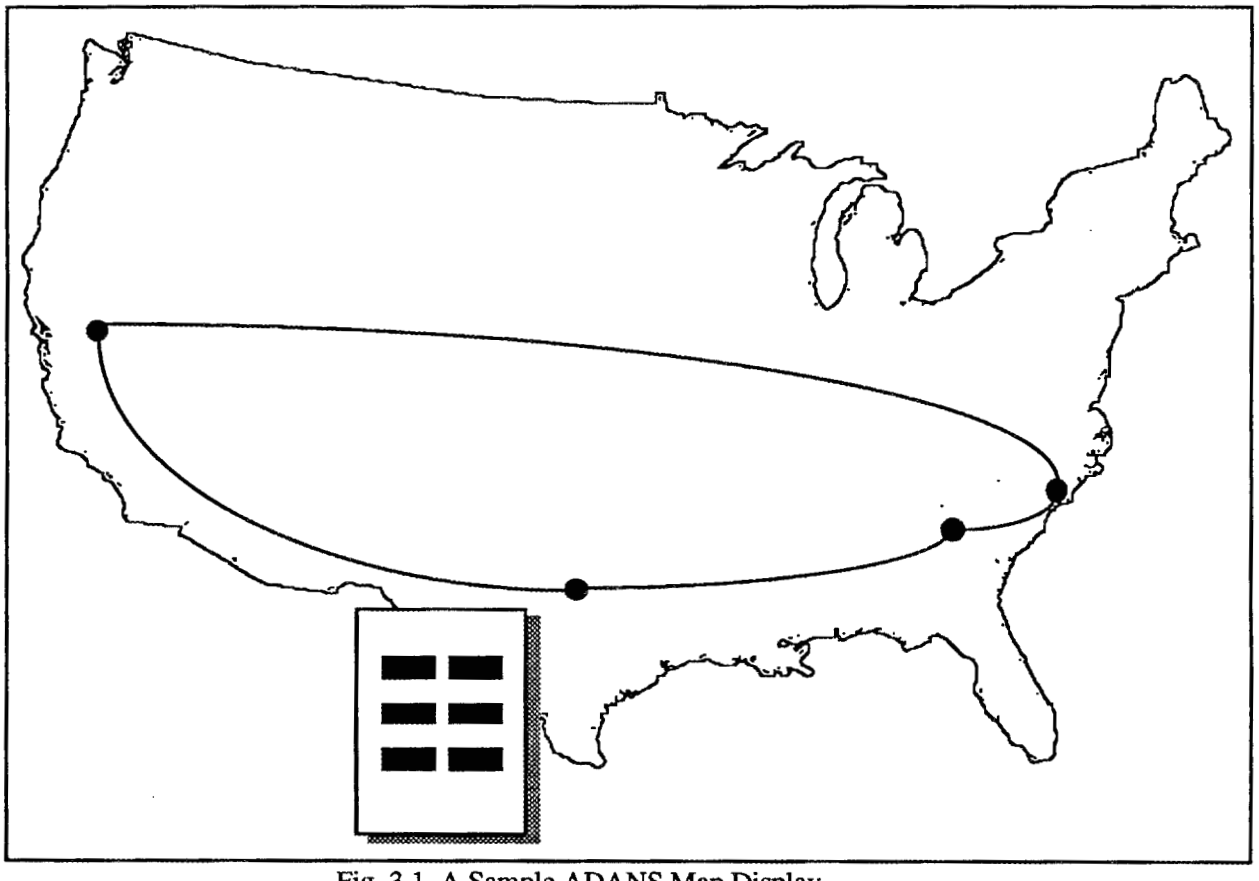

Fig. 3.1. A Sample ADANS Map Display
A pop-up window with six station parameter options is shown for a particular station in a schedule.

The trade-off to be considered for information density on a display screen is straightforward: too much information clutters a window and can actually obscure transportation information; too little orientation detail, however, can require conscious effort to relate a planning effort to the real world or can hide relevant details a planner might use to make "non-algorithmic" improvements in a developing plan. There is also a hardware trade-off because it takes additional time to draw extensive detail. In any case, users should be able to add or remove categories of default information from their unique user profiles, with minimal assistance from the system administrator.

3.3.2 MAC-Specific, Map-Based Data

Superimposed on the default display map will be user-selected data drawn dynamically from the ADANS database by alphanumeric applications. For example, missions and mission stops could be specified and retrieved by an application and thereafter be displayed on a map. Other entities will be added to the list after consultation with application developers and experts from MAC. The list of entities and their real-world attributes currently designated to be displayed for map windows is shown in Appendix B.

After consultation with MAC users, some attributes (and some ranges of attribute values) will be selected for highlighting on the screen so that the user's attention will be drawn to significant features of the data. Such highlighting can be redefined dynamically, by menu choices of the users, to meet specific requirements of different planning tasks.

3.3.3 Selection of Data in Context

Instead of requiring users to overtly choose MAC data for display, developers of programs for specific alphanumeric applications (accessed by the menu as discussed in Sect. 3.2) can create queries for subsets of data specifically for display. Those predefined data sets are then retrieved automatically when the user switches from the alphanumeric window to the map graphics window.

3.4 THE TIME-CHART GRAPHICS WINDOW

MAC mission data are inherently time-dependent; thus, some aspects of a mission are easier to comprehend when displayed in a time-based window rather than on a map. Accordingly, the third major type of ADANS data display is the time chart, where time is represented as one of the axes of a chart. Time-chart displays are based partly on their precursors, the "Rainbow" charts used for scheduling at the 22nd Numbered Air Force (NAF). The scope of these charts is extended to integrate the display with the ADANS database, alphanumeric applications, and map displays. The precise design of the time charts has not yet been determined; the design process is expected to draw heavily from Rainbow chart examples as well as from graphics prototypes produced by ORNL and by ORNL subcontractors.

3.4.1 Levels of Time Interval Detail

Some MAC users of ADANS have default time-chart displays that are easy to define. For example, deliberate plans include a well-defined interval of pseudotime, and the complete set of planned missions during the pseudotime interval could correspond to a fully detailed world map. Such a complete time chart would become very cluttered if too much information were displayed about any single mission. However, an overview time chart might give a valuable sense of the progression of a plan.

In most cases, it will probably be a more useful approach to allow the user to define (from an alphanumeric screen or with the cursor on a graph) the beginning and end of a time period of interest and to display more mission details about fewer missions. For example, during any particular ADANS work session, planners of Channels missions should be able to select and display missions planned for the few weeks for which they are trying to devise effective schedules.

3.4.2 Region or Station Selection

In addition to selecting a time interval, an ADANS user is able to select (from an alphanumeric screen or with the cursor on a map or graph) a limited region or set of stations for which detailed time behavior can be displayed. If a subset map region has already been chosen by the user, that subset region becomes the default region displayed on the time chart. Such a default may be overridden by the user.

3.4.3 Mission and Resource Details

When mission or resource details are required by the user, a portion of the time chart may be expanded to show those database entities whose attributes are best displayed as time-dependent values. The amount of parking space available/occupied at a station is an obvious example. Specific entities from the ADANS database that are suitable for time-chart display are listed in Appendix B, in addition to the attributes for which display characteristics are defined.

As with the map displays, after consultation with MAC users, some attributes (and some ranges of attribute values) will be selected for highlighting on the screen so that users' attention will be drawn to significant features of the data. Such highlighting can be redefined dynamically, by menu choices of the users, to meet specific requirements of different planning tasks.

3.5 CONTEXT SENSITIVITY AND RELEVANT DISPLAYS

The ADANS database contains a large amount and variety of data. To present a useful subset of that data to the user, the ADANS L&F is relevant to a user's database access. Consequently, inherently geographic data are presented on maps, time-dependent entities are shown as related functions of time, and the two types of data are correlated by visual cues on adjacent windows. When actual data manipulation is required, the user has access to data-entry screens where numbers and text can accurately represent the required information. At every point, the user is able to expand or contract the scope of data access, subject only to access permissions and the bounds of effective screen presentation.

4. ADANS APPLICATIONS DESIGN GUIDELINES

4.1 INTRODUCTION

This chapter defines a set of basic guidelines for designing ADANS data-entry and data-display windows. Sybase is the relational Database Management System (DBMS) selected for housing ADANS data, and all development of applications windows is to be done using Sybase's APT forms editor tool. A need for Ada applications has been identified; however, the user interface will still be accomplished using windows produced through the APT forms tool. Every effort will be made to exercise APT's capabilities to the fullest.

These guidelines generally apply throughout all of the APT forms development. However, because ADANS employs keyboard and mouse features, certain guidelines apply to only one of these features and will be noted as such.

4.2 THE APT FORMS

The Sybase APT term "form" refers to the front-end mechanism by which data entry, retrieval, and manipulation are performed. Forms are displayed within a SunView window. APT forms have two aspects: the data portion and the menu portion (see Fig. 4.1).

On the first APT application accessed by a user, blue is the background color for the display area, and white is the foreground color. It is possible that ADANS users will need to invoke more than one APT form during a work session, with the forms shown simultaneously. A maximum of three forms can be displayed at any one time. All active APT forms that access temporal data are related to a single map and/or time-chart display. Courier bold is the standard font to be used in the development of APT forms. Acceptable point sizes are 12, 14, 16, and 18, with the default being 16. Recommendations regarding where forms are to be displayed on the screen have yet to be determined. It should be noted that there are several concerns that are independent of any recommendation: font size is an environment variable that the user can set to accommodate personal preference. Form size and form position recommendations can be made, but the appearance and

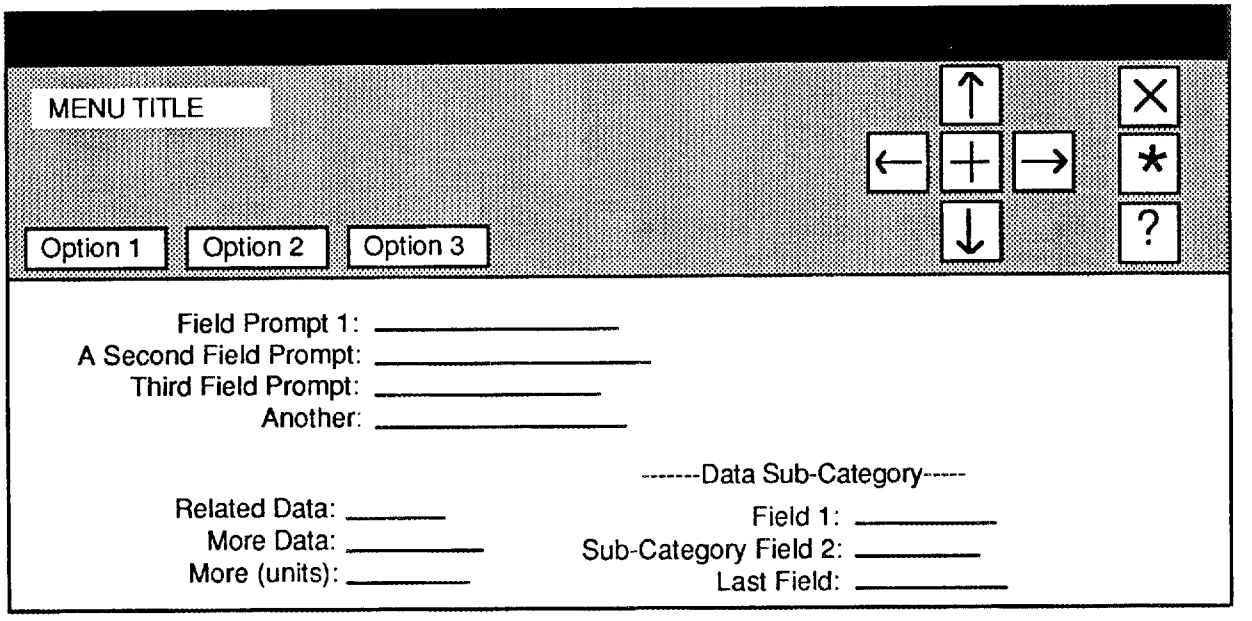

Fig. 4.1. A Sample APT Application Screen

usability of the forms can be altered by the user if the font size is customized so that it is different from the font used when the forms were designed.

Form size and forms placement on the screen is an integration task relative to the L&F work (Sect. 3) rather than a concern of the application developers.

APT forms have four kinds of objects: the form itself, fields, groups, and menus. Menus are composed of a menu bar, a menu title, menu options and items, and icons (see Fig. 4.1.). Menus are discussed in Sect. 4.2.1, and the form, fields, and groups that deal with data input/output are discussed in Sect. 4.2.2.

4.2.1 The APT Menus

Menus are an optional part of the form. In ADANS, menus will be used to describe the activity of the form. They will not be used as navigational menus to other applications.[3] On menus, the menu options indicate the action to be taken with the form.

"MENU TITLE" is the name of the menu, as well as the title of the window; it describes the purpose/activity of the application. A menu title, which is positioned in the top left-hand corner of the APT menu bar, is formatted in all capital letters. The length does not exceed 30 characters (Sybase limit). Menu titles are nouns, with or without modifiers, and are unique within a component (e.g., within the Channels portion of ADANS).

The menu title is not necessarily the same as the file name (i.e., the ".frm" file name without the .frm extension), though there should be some correspondence.

"MENU OPTIONS" are left justified and appear left to right on one line. The first letter of each important word of the option is capitalized; all other letters are lowercase. The APT documentation does not indicate size limitations of option names; however, longer option names limit the total number of options. Options are verbs or directions. Examples of options are "Add," "Change," "Delete," or "Next Page." When an option is "doable," it will be highlighted to indicate accessibility.

The final character of the option may be ! or -> (as provided by the Sybase APT). When a menu option is selected, a Pull Down Menu appears. If a menu option is followed by "!", then the menu option has no further options. If a menu option is followed by a "->", then a Slide Off Menu will appear. The Slide Off Menu feature will not be used in ADANS.

The standard menu icons [predefined Scroll(+), Help (?), Exit (X), and Tools (*)] will be used when appropriate, with the decision of appropriateness left to the designer. For a more complete description of the Help feature, see Sect. 4.4. A complete description of the use of tools (*) has yet

[3]Within a related procedure and with sufficient justification, some menu navigation through forms will be acceptable.

to be determined. It is anticipated that a generic set of ADANS tools will be developed and placed in this icon for all applications, but this has not been fully explored. Currently, there are two items to be placed under tools. The first is "Printform" using the Sybase APT supplied procedure, and the second is "Clearform." Clearform will use one of two routines, at the discretion of the application designer.

4.2.2 The APT Data Portion

Field prompts are formatted by capitalizing the first letter of the initial word and of every important word (i.e., everything except articles, conjunctions, and prepositions of less than five letters). Field prompts should be meaningful indications of the data they represent. The size of the field prompts should be kept small — preferably one or two words, with a limit of 15 characters (the Sybase limit is 60 characters). A colon (:) is placed after the last word of the prompt. Groupings of data are aligned on the colons. Field prompts are right adjusted to the colon; data fields are left adjusted to the colon. When the ADANS user accesses the application, one space follows the colon (before the data field).

Do not include a space to the right of the colon in the prompt portion because Sybase automatically includes a space to the left of the data field.

The length of the data field is indicated by highlighting, which indicates to the user the permissible size of the field. For fields that are longer than the amount of space available on the application screen, the scroll feature is used to enter/view the rest of the data.

Highlighting, in combination with the standard blue-white color scheme previously described, results in blue background for forms, white letters for fields labels, white shading denoting field length, and data within the white shaded area in blue. Field size defaults to the size of the data type for all data fields. Sybase advises (and ADANS will follow this advice) making the display size of all data fields two characters greater than the size you intend to display. However, for very large fields, fewer characters than the actual maximum character length can be displayed using the scroll option. For fields that are longer than the amount of space available on the application screen, an appropriate field length can be displayed and the scroll feature used to enter/view the rest of the data.

Except for log-on and password type screens, data fields generally display the data as entered.

The display of data in fields is accomplished by setting the echo option to "yes." Hidden fields will not be displayed. Hidden fields are used by the application programmer as a repository for information pertinent to the application but not to be viewed by the user. The issue of hidden fields is up to the discretion of the application programmer. It has not been determined whether there is a need for standard hidden fields for each form of ADANS.

Although Sybase allows the choice of autotabbing through fields when the current field is full, autotab is NOT used in ADANS.

The autotab option, which is only meaningful with respect to keyboard access, is set to "off" for each field by the designer.

Information is displayed on the screen in a logical way, such that each screen displays similar information and/or represents the order in which business is done. Cursor movement compliments the presentation of data on the screen. Thus, data field arrangement and cursor movement is from left to right and top to bottom.

APT allows you to control the sequence of fields to which the cursor moves on the form. Do not present the screen in a nicely organized fashion only to program the cursor to "bounce around."

Cursor progression through a column of information is top to bottom; progression through multiple columns is generally left to right, top to bottom. There may be situations where this guideline does not conform to how the user does business; in such instances, top to bottom and then left to right progression through multiple columns may be acceptable. An example of this exception is progression through a spreadsheet.

Single spacing is used within data groupings; double spacing is used between groupings. The use of subheadings for groups is recommended if the subheading clarifies the information in the group. When subheadings are used, they appear centered over the groupings in initial capital letters, with no punctuation. In some instances, when headings are noticeably narrower than the data within the group, the subheading may include dashes (-) to the left and right of the subheading to denote the information to which the subheading pertains (see Fig. 4.2).

---------- **Fuel** ---------

Rate (lb/hr): 22458
Approach and Landing (lb): 5000

Fig. 4.2. Sample of a Subheading with Dashes

Multiple rows of display are handled through the APT group definition capability. APT is liberal about the maximum and minimum number of rows that can be displayed at one time. The determination of the appropriate number of rows is left to the discretion of the screen designer, but the use of this feature should be such that the screen is consistent with the overall screen guidelines and does not look too busy. The application developer has limited control over the spacing between the data columns composing the group. Column labels must sometimes be stacked in multiple lines in order to identify the contents of the column. Fig. 4.3 illustrates these guidelines.

Aircraft Type	Crew Changes	Off-load	On-load	Fuel
747-100 TWA	Y	Y	Y	Y
B747-200F F-TIG	Y	Y	Y	Y
C130E	Y	Y	Y	Y
C141B	Y	Y	Y	Y
C005A	Y	Y	Y	Y
DC10-40	Y	Y	Y	Y
DC8-63F TRANSAM	Y	Y	Y	Y
L-1011-100	Y	Y	Y	Y

Fig. 4.3. An Example of Columns with Stacked Headings

Avoid more than two lines of stacked heading.

When multiple rows of display are used as a basis for selecting a particular row for additional information or processing on another form, the current row will be highlighted.

4.3 OTHER APT FORM FUNCTIONS

4.3.1 Form Identification

The form identification is the APT menu title. Some applications are too complicated to be contained on one screen. For example, a single data-entry function might require two or more totally different data-entry pages. These types of applications require continuation pages, for which each page must be identified. The phrase "Page x of y" (where "x" and "y" are replaced by the number of each screen and the total number of screens, respectively) indicates to the user that there are additional pages associated with the application. This phrase is positioned in the lower right-hand corner of the form.

4.3.2 The "Working" Message

If a process takes longer than 5 seconds, a message must appear to the user in the lower left-hand corner telling the user that the request is being processed. The format of this message is "Working ..."

Although Sybase cannot keep track of processing time and therefore does not know when 5 seconds have passed, code has been developed to provide the "Working..." message in an appropriate time frame. That is, when information is sent to the server, the message appears in a window on the APT form if the request to the server takes longer than 5 seconds.

4.3.3 The "Caution" or Warning Message

If a user requests an action that is potentially disastrous — for example, deleting a row — a message will appear to the user requesting confirmation of the instructions. The format of this message is "Are you sure (Y/N)?" In some circumstances it may be more specific, for example: "Do you want to delete all of the station information (Y/N)?" The user must respond with a "Y" or an "N."

The presentation to the user of this message is being prototyped as a small window which would ask the user "Are you sure (Y/N)?" and return the response to the calling program; the processing course (continue action or cancel) would be based on the returned response.

4.3.4 Data Validation

Most data-entry fields have some data validation, the appropriateness of which is known by the system developers. Data validation occurs twice in the course of user interaction. At the time of data entry, if the user types invalid data in a field, the user is alerted to the error with a message, and the cursor is positioned at the invalid field for user correction. The format of the message is "Invalid data; reenter or consult Help." Data validation takes place a second time when a user invokes a "change" or "add" option. Validation for field interdependencies also occurs, and messages indicating errors are produced.

The database has triggers and rules to catch errors that programs overlook, but triggers and rules should not be excuses for not performing data validation within each form.

4.3.5 Error Messages

Error messages are invoked in two different ways. Data-specific error messages are entered by the screen designer through the rule-message capability. System error messages just happen; for

example, if the user enters more characters in a field than the maximum allowable number, a standard message to that effect appears.

The application programmer has no control over where the message appears on the screen. It is possible to intercept "unfriendly" Sybase messages, but the topic has not been completely explored.

4.3.6 Use of Units of Measure

See Appendix A for a listing of abbreviations of units of measure that are appropriate for ADANS screens. In Fig. 4.4, examples 1 and 2 show placement of units if they appear in field prompts or column headings, respectively:

Example 1

Prompt (ft):	_____	Field Prompt:	_____
Another (miles):	_____	Prompt with Unit of Measure (sec):	_____
Time (hr):	_____	Something Else (unit):	_____

Example 2

Data Relating to a Plan

Plan ID	Miles Traveled	PAX	Time (hr)
xxxxx	111111	22	33

Fig. 4.4. Examples Depicting Unit of Measure Placement

4.4 HELP

Help is provided to the user in a variety of ways. Messages indicating the status of an action will be provided. A sample listing of these messages is as follows:

"Addition completed." — indicates that an Add took place.

"Changes have been made." — indicates that an Update took place.

"Deletion completed." — indicates that a Delete took place.

"Connection error - try again." — indicates that an action failed at the Channel/Server level.

"Invalid data; reenter or consult Help."

APT allows users to get field-specific Help through two mechanisms: ctrl-v and the "?" icon. Help through ctrl-v (see Sect. 4.5) provides valid choices for the field. The availability of this type of Help is indicated by including an "@" after the prompt for each field with this capability (e.g., "ICAO@: _____."). Help through the "?" icon provides a context-specific Help message.

The content of the ctrl-v Help information is specified by an SQL query entered in the entry-values field by the screen developer at the time of screen design. When activated, the information is displayed in the center of the screen with no way to control this placement. The information is displayed in column format, with one row for each row found as the result of the SQL entry. Therefore, the length of the information displayed is dependent on the number of rows returned by the server. This display provides useful information to the user, and the use of this feature is left to the discretion of the application programmer.

In addition to the list of values feature, a field-specific on-line Help feature will be available in the Increment I deliverable of the Channels module. This brief Help message is available only on enterable fields and is accessed by pressing the "?" icon. Since there are limitations to this type of Help, a more extensive Help package is being planned for inclusion with the delivery of other modules of Increment I. Finally, for Increment II, a context-sensitive hypertext Help utility is proposed. Additional information about the ADANS Help function will be provided at a later date. This additional capability may need to be implemented by the application programmers through Sybase APT and retrofitted to existing forms.

4.5 APT RESERVED KEYS AND ICONS

APT has certain keys and icons that are reserved for specific functions. Some of them and their uses are described here. For a full list, the user invokes "Help (?)" and then selects "Key Guide!" from the pull-down menu.

1. ctrl-v is a Help function ; it allows users to view a list of appropriate values for a specific field.

2. ctrl-p is used to back tab (i.e., progress through fields in "reverse order").

3. The standard menu icons, predefined Scroll(+), Help (?), and Exit ("X" on the menu bar or R3), will be used when appropriate, and the decision of appropriateness is left to the designer. A complete list of how the tools (*) are to be used is yet to be determined; probably "printform" and "clearform" will be included. "X" (menu bar) is the generic exit from within menus. The "X" can be replaced by a menu option, but the documentation indicates that some additional processing will have to be programmed. ADANS will use the standard "X" icon.

4. ctrl-r allows the user to switch between the menu bar (for access to the options and icons) and the data input/output area.

5. R1 or ctrl-k allows the user to enter command mode. When the cursor is in the menu bar, a user can move to any option in the menu bar by typing its sequential number. The other option is to use arrow keys to select the option and then to press enter. This feature enables the user to access the arrow keys for scrolling through forms that are logically bigger than the physical screen size.

6. The tab key is used to go to next field.

7. Next (ctrl-n) is used to go to next field.

8. ctrl-x will delete the character where the cursor is positioned.

4.6 APPLICATION PROGRAMMABLE FUNCTION KEYS

APT allows function keys to be programmed. Currently, there are no function keys that are programmed for ADANS.

4.7 CONSTRAINTS

There is concern about users pressing keys or combinations of keys that would have undesirable consequences. For example, ctrl-c usually triggers a program abort. Sybase does not provide a mechanism for disabling keys, and extensive testing of the consequences of pressing different keys and key combinations has not been done. Pressing ctrl-c results in a window that presents the user with the option to resume processing or exit out of the form.

5. SUMMARY AND RECOMMENDATIONS

The user interface for ADANS helps the user interact with a large database and a complicated algorithm. Incorporating menus, data-entry applications, reports, and graphics as part of the design, the interface communicates complex information to aid the user in making airlift-scheduling decisions.

ADANS is under development. Therefore, it is not a static program, nor is the user interface a static design. Some desirable capabilities are now lacking because of software or hardware limitations. It is expected that, as enhancements to ADANS software and/or hardware occur, enhancements will be incorporated into the interface design. We expect changes in the following areas.

1. Color, tastefully used, can enhance the user interface of any computer application by reducing clutter and highlighting data. Color with respect to Sybase APT forms is currently not available. This is regarded as a limitation of Sybase and a restriction on the potential of ADANS. If and when color becomes available, color will not be depended upon as the sole means of communicating with the end users. Color will be used to place emphasis on error situations, to group data based on some criteria, and to emphasize data. The users are currently provided with an error or caution message (if appropriate); when color becomes available, it <u>may</u> be used for enhancement of ADANS screens, but it will <u>never</u> replace explanatory messages to the user.

2. The use of audio alarms to alert users to errors or to a potentially harmful situation is not currently possible. The capability to trigger audio messages (e.g., a "bell" sound) should be examined as a future enhancement.

3. Section 4 does not provide guidelines for displaying numeric data. Although the capabilities are not available with the current form-development tool, the following display conventions are desirable:

    a. Indicate the number of decimal places to be used with a field whose data type is float.

b. Indicate leading zeros on numeric data fields rather than space-fill leading zeroes (useful for expressing relative time as in, for example, day C003).

c. Align fields with decimal points on the decimal points.

Recommendations for future interface guidelines include the following:

1. Address the above points in a revision of the User Interface Guidelines (when the capability becomes available).

2. As soon as possible, write a definitive report on the Help screens.

3. If Ada is used for applications development, write guidelines to address this need.

4. Develop guidelines for the use of the "tools" facility in APT forms.

APPENDIXES

APPENDIX A
LIST OF APT SCREEN ABBREVIATIONS AND ACRONYMS

The following lists include all abbreviations and acronyms used on ADANS screens. Any abbreviation/acronym not appearing in these lists should not be used without prior user interface team approval and incorporation into the approved list.

Periods are used after abbreviations ONLY when the abbreviation itself is a word (e.g., "in." for inch). Also, please note that there is no "s" on the plural form of abbreviations for units of measure.

Unit of measure	Abbreviation
cubic feet	cu ft
days	days
foot/feet	ft
inch(es)	in.
gallon(s)	gal
hour(s)	hr
measurement ton(s)	mton
miles	miles
minute(s)	min
pound(s)	lb
short ton(s)	ston
square feet	sq ft
average	avg
maximum	max
minimum	min
number	No.
passenger	pax
throughput	thruput
troops	pax
yes/no	Y/N

Remember to capitalize the first letter (only) of the abbreviation if it is used in a prompt. In general, place abbreviations for units of measure in parentheses before the colon. For example, use "Distance (miles):." If the abbreviation is contained within parentheses, do not use a capital letter.

Phrase	Acronym
Aerial Port of Debarkation	APOD
Aerial Port of Embarkation	APOE
Airlift Division	ALD
Airlift Services Industrial Fund	ASIF
Earliest Arrival Date	EAD
International Civil Aviation Organization	ICAO
Latest Arrival Date	LAD
Utiliization (flying hour)	UTE

APPENDIX B
DISPLAYABLE ENTITIES

The analysts and software developers at ORNL who have been working on ADANS have a pool of expert knowledge about the needs of the ultimate users of the ADANS software. The form shown on the following page was devised to tap that pool of knowledge and to encourage ORNL experts to suggest that MAC data be displayed on the two types of graphics windows supported in Increment I of ADANS. The following page is a sample form prepared and distributed to the team. Additional forms will be included in the future revisions of this document as they are submitted by the team. This appendix is expected to grow as additional suggestions are made by the software developers and their MAC counterparts.

ADANS Entities to be Displayed

Basic Display Type: Map_____
Purpose/Description: To display permissions for a set of MAC stations.

Reference APT form: EDITPERMS.?___
Tables Read: AIRCRAFT_CATEGORY_PERMISSION_____

_____

PLANSET_STATION_ _____

_____

(View Name: _____)

Typical Query:
SELECT ____, ___, _____

FROM AIRCRAFT_CATEGORY_PERMISSION

WHERE aircraft_category_code is ____ and planset_id is ___

Table.field	Selection	Display	Comments
AIRCRAFT_CATEGORY_PERMISSION.etc			
.aircraft_category_code	Y	Y	
.planset_id	Y	N	
.station_id	Y	Y	
.station_use_enroute	N	Y	color flag
.station_use_offload	N	Y	color flag
.station_use_onload	N	Y	color flag
.station_use_recovery	N	Y	color flag
PLANSET_STATION.etc.			
.planset_id	Y	N	
.station_id	Y	N	
.current_fuel_amount	N	N	pie chart
.max_pax_per_day	N	Y	

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