Chapter Two
Development and Evaluation of Improved Display Prototypes

2.1 Summary

The purpose of this task was to develop prototype displays to demonstrate how existing Flight Standards Service (AFS) reference documents and databases would benefit from the application of a user-centered design approach to display design. Two prototyping efforts were completed under this subtask. The first effort was to develop a user interface that would address the problem issues with the Flight Standards Automation System (FSAS) that were identified in a related subtask. The second effort was to develop a multimedia prototype of an Inspectors Handbook. These prototypes capitalized on graphical user interface (GUI) technologies and Human Factors research on information presentation (color, formatting, direct manipulation, etc.). These prototypes emphasized ease of use and information utilization. The research team evaluated these prototypes in cooperation with aviation safety inspectors (ASIs).

2.2 Database User Interface Prototypes

The detailed study of the Flight Standards Service (AFS) database systems, as documented in the previous chapter (Chapter 1), outlined the manner in which the ASIs interact with the numerous database systems provided for their use. As a result of this study, several inherent weaknesses that are unique to the Flight Standards Automation System (FSAS) were identified. Please refer to Chapter 1 for a detailed description of these weaknesses.

A prototype user interface display was developed to demonstrate how the FSAS user interface could be improved. During development, several trips were made to the Atlanta Flight Standard District Office (FSDO) to demonstrate the prototype and to gather feedback on our efforts. The responses received from the ASIs and managers were positive. They felt that the functionality which the prototype provided would be very helpful in allowing them to perform their daily tasks.

During the detailed study of the AFS existing database systems, we were informed that the AFS is planning to upgrade the existing Paradox database system to a client/server environment in the near future. In this environment, processing is split between powerful servers and desktop machines. A powerful computer usually functions as the database server, which services the clients' requests. A less powerful desktop computer running a Windows-based system functions as a client and makes request to the database server. The prototype demonstrates some of the benefits that the AFS will realize when it makes the conversion to the client/server database environment.

The prototype is not a fully functional FSAS system. It merely demonstrates how some of the FSAS weaknesses can be addressed. The prototype only emphasizes enhancements to the Program Tracking and Reporting Subsystem (PTRS) and Vital Information System (VIS). However, the issues addressed in these two subsystems are applicable to the other FSAS subsystems as well. The following is a detailed description of the prototype, the weaknesses it addresses, and how these enhancements will benefit the AFS.

2.2.1 FSAS Weaknesses Addressed

To address all of the weaknesses identified in Chapter 1 would be beyond the level of support provided for this activity. The prototype demonstrates enhancements to a subset of the FSAS weaknesses identified. The following is a list of the items that the prototype covers.

1. Demonstrate FSAS improved functionality in the Windows environment.
2. Provide data entry guidance to users within the Windows-based FSAS.
3. Demonstrate a more efficient search function within the Windows-based FSAS.
4. Demonstrate an easier way to access supporting subsequent screens (e.g., comment screens) within the Windows-based FSAS.
5. Demonstrate a more efficient text editor for entering comments within the Windows-based FSAS.
6. Demonstrate how selected Windows-based FSAS subsystems interact if the subsystems were more tightly integrated.
7. Demonstrate how selected Windows-based FSAS subsystems function if the database was normalized resulting in the elimination of duplicated data between the subsystems.
8. Demonstrate an improved ad-hoc reporting function. This new reporting function was not demonstrated by the prototype, however, various ad-hoc reporting tools that work within the Windows and client/server environments were investigated and are documented in this report. These issues are explained in detail in the following sections.

2.2.2 FSAS in the Windows Environment

The current implementation of FSAS is a DOS-based, Paradox-driven application that is not compatible with the Windows operating environment. The ASIs and other AFS users often use several Windows-based software packages along with FSAS on a daily basis. Both FSAS and the Windows Operating System cannot operate simultaneously on the ASI's desktop computer. Therefore, if a user is in FSAS and he/she needs access to a Windows-based software package, the user will be required to exit FSAS and then start the Windows Operating System.

This prototype demonstrates how a Windows-based FSAS system would operate in a client/server environment and how it would benefit the AFS. Because this FSAS prototype adheres to standard Windows design, users who are already familiar with Windows will also be familiar with the functionality of the prototype. Each subsystem is designed using the MS Windows standards for a common look and feel thus ensuring similar functionality. Hence, very little time will be spent retraining users to use this system.

The prototype attempts to guide the users through the system. Emphasis is placed on ease of use and on presenting the users with valuable information when appropriate. Figure 2.1 shows the main FSAS screen. From this screen all FSAS subsystems (PTRS, VIS, OPSS, KEYMGR, JOBAIDS, and PLANNING) are accessible. The user-id and user information displayed is acquired from the Flight Standard Electronic Office system (FSEO). The FSEO system provides a single point of user login. Please refer to Chapter 4 for a detailed description of the FSEO software. The prototype demonstrates how the user can be aided by presenting the most frequently used choices. Figure 2.2 represents the VIS main entry screen which contains the most often used functions. The screen allows the user to select the appropriate form from the form type section and then to select whether to create a new form or open an existing one. The description on the bottom of the screen describes the form type that is selected. The options presented on the main screen (Open, New) can also be accessed from the Activity menu option. Figure 2.3 is a representation of the activity menu. The Edit menu offers the standard edit options available in the windows environment such as Cut, Copy, Paste, and Clear.

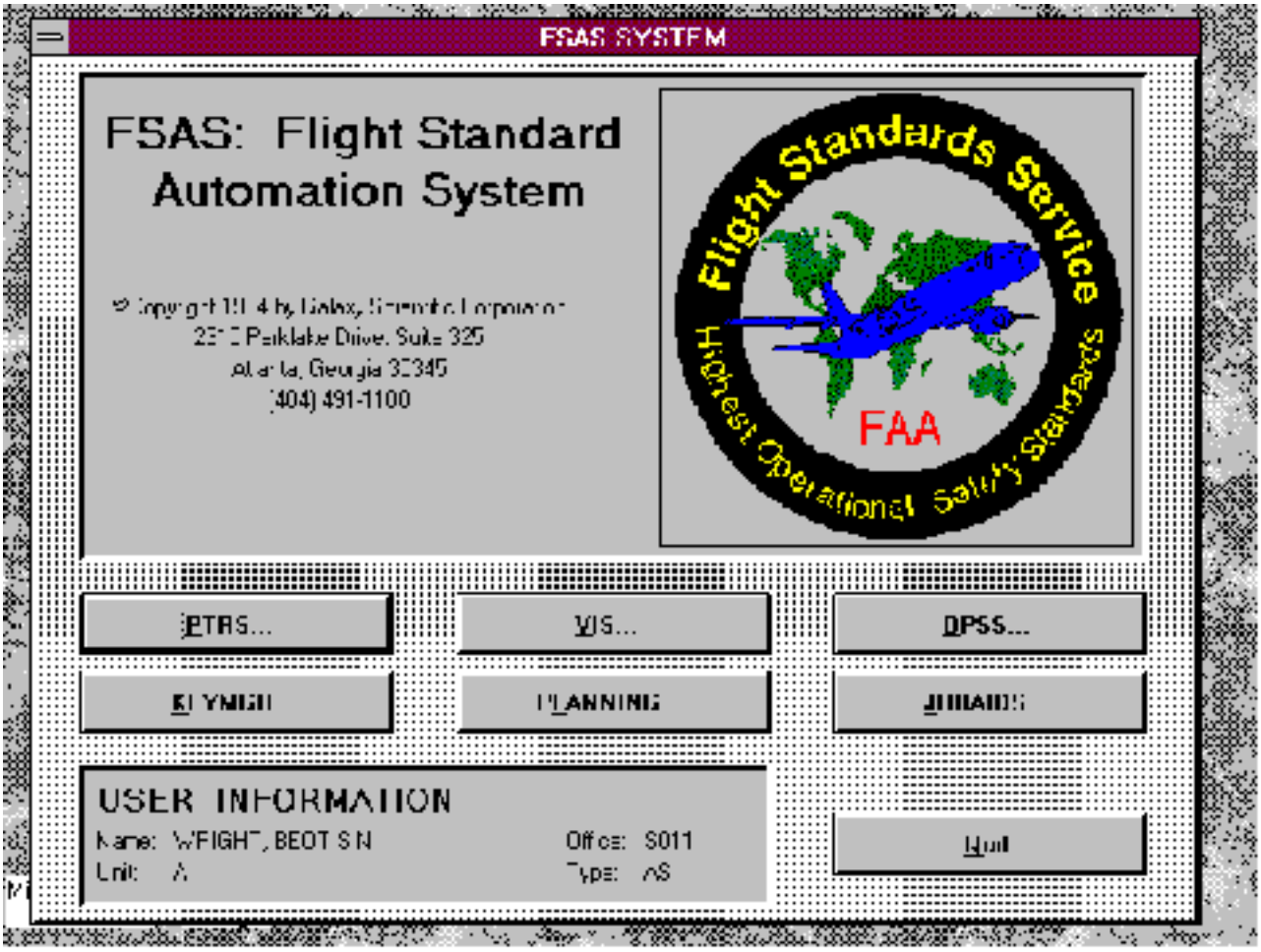


Figure 2.1 Main FSAS screen

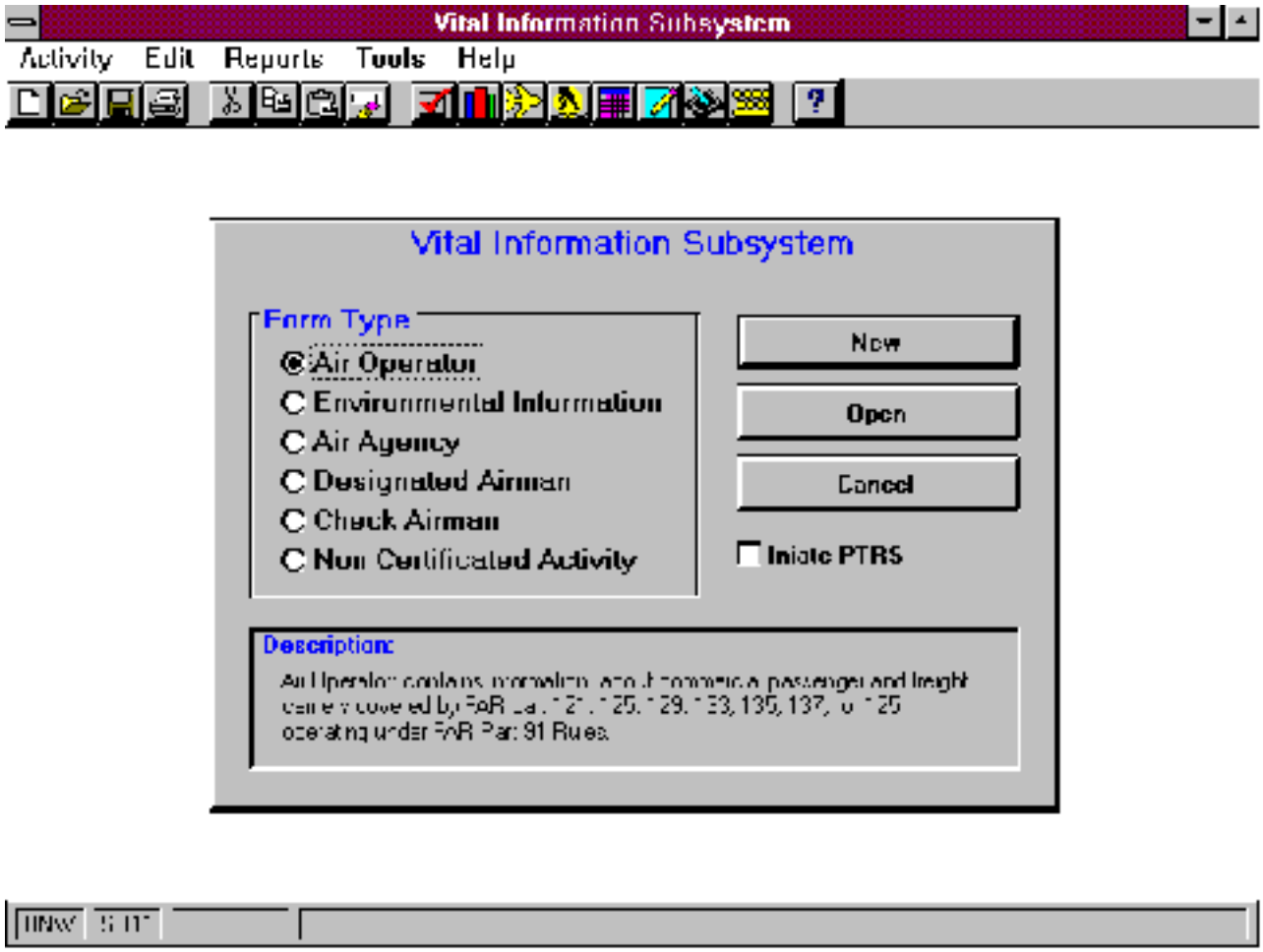


Figure 2.2 VIS main entry screen

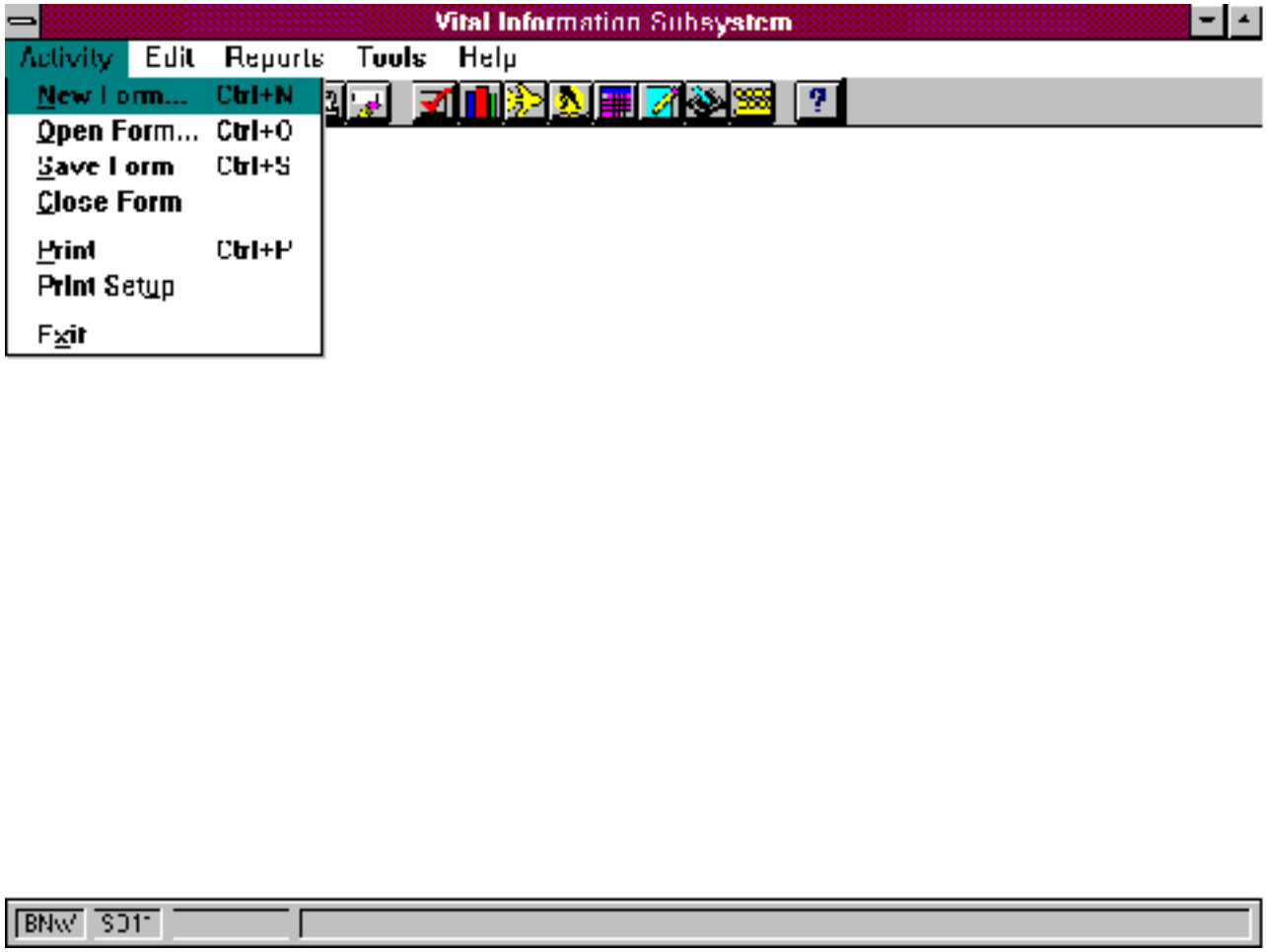


Figure 2.3 VIS activity menu

These options under the Edit menu allow data to be copied within or between applications. The Reports menu option will provide access to pre-defined reports and to the ad-hoc reporting system. The Tools menu provides quick access to PTRS and VIS. The Tool Bar located at the top of the screen provides the same functionality as the menu items, but it presents the choices in a graphical form. A balloon help function was integrated into the prototype so that whenever the cursor is moved over an item on the Tool Bar, a brief description of the item is displayed. Figure 2.4 illustrates this functionality. The Tool Bar can also be customized by the user. It can be used to gain quick access to frequently used applications. Therefore, some items on the Tool Bar, such as the one depicted in Figure 2.5, are optional.

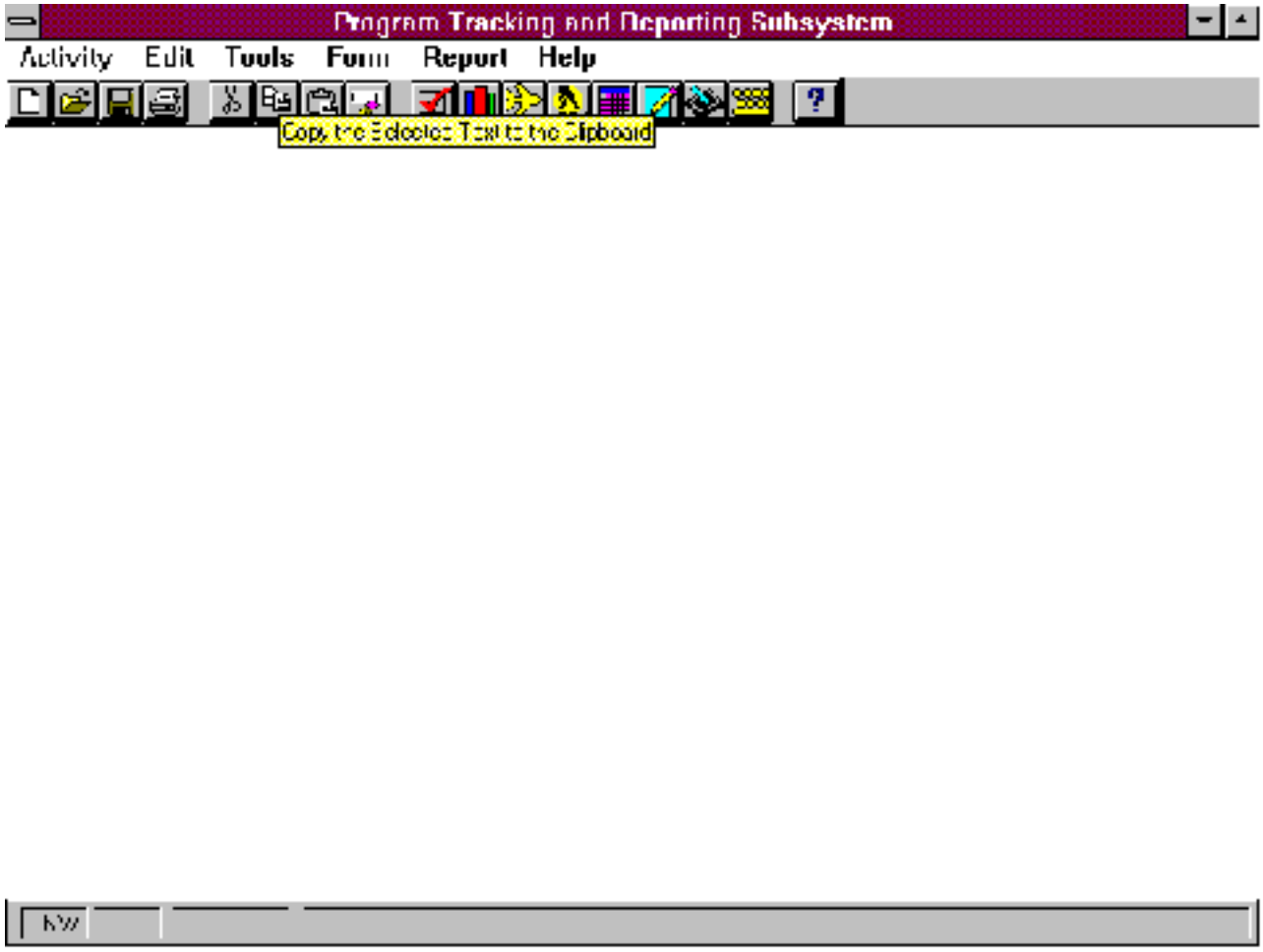


Figure 2.4 Balloon help function

The AFS intends to convert all of the major safety-related database systems to run within Windows. When this takes place, the ASIs and other AFS users will no longer be required to exit one subsystem in order to start another. This will reduce the time and effort it takes to access these subsystems. In addition, by having all major systems running under the Windows environment, data can be easily transferred within and across subsystems. For example, if an ASI needs to write a memo in MS Word and he/she needs to reference information in FSAS, the ASI can transfer this information from the appropriate subsystem to the memo directly by using the standard cut and paste functionality in Windows. Another advantage of having all major database systems running in the Windows environment is that several safety-related subsystems can be run simultaneously. Therefore, a user can potentially have PTRS, VIS, and OPSS running at the same time, which is important if the user needs to copy information across subsystems. The only limit to the amount of subsystems that can be up and running simultaneously is the amount of memory that is installed on the user's desktop computer.

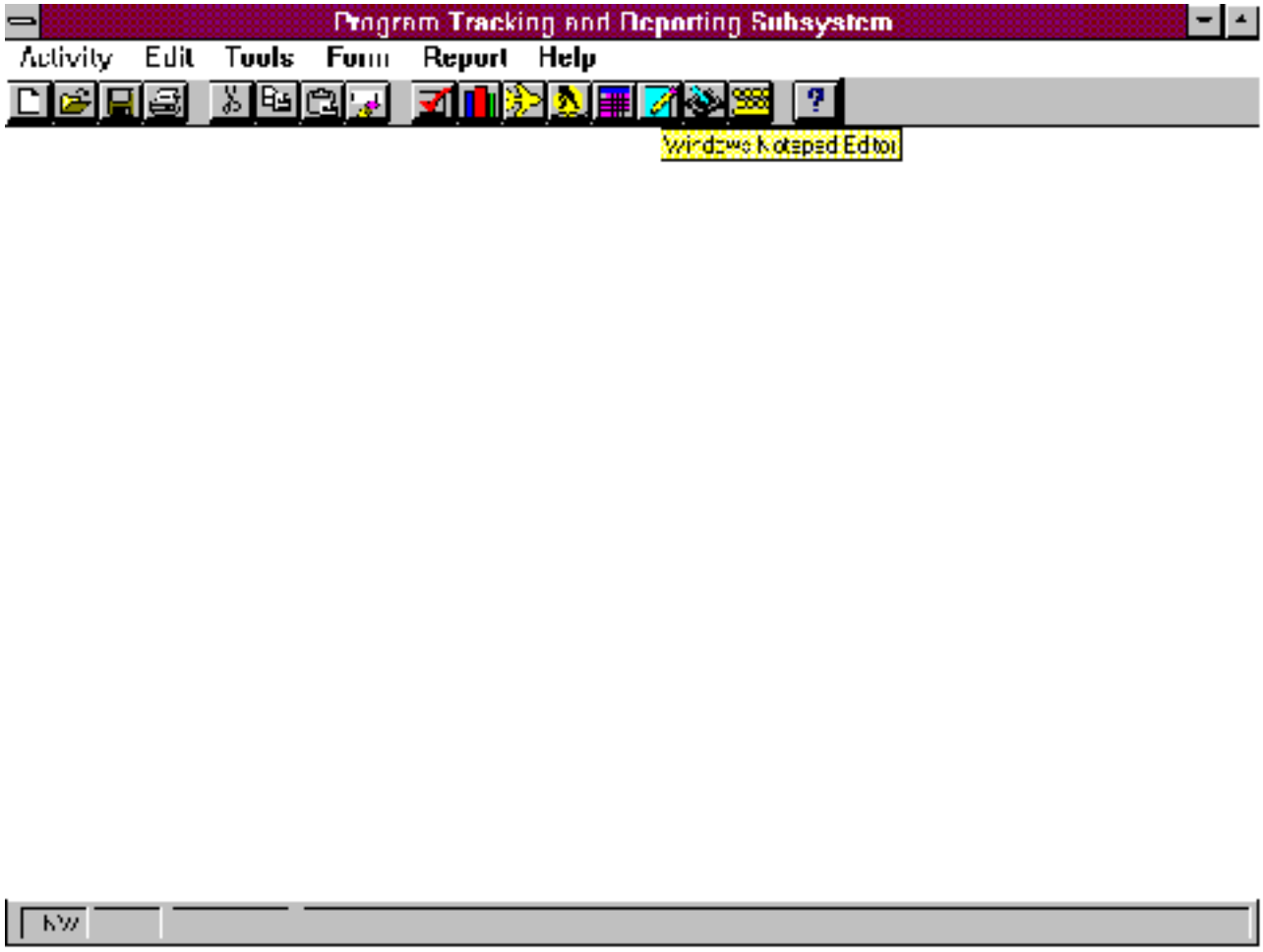


Figure 2.5 Optional tool bar

The AFS will eventually migrate its major applications to the Windows environment, but this will take time. This will result in some systems continuing to reside on the mainframe computers before the transition is complete. However, access to the mainframe via Windows will not be a problem because there are several software packages on the market that effectively address this issue. Procomm for Windows and IBM Personal Communication System are two such packages that will allow users working in the Windows environment to access the mainframe. This will allow a user to cut and paste information from mainframe applications to Windows-base PC applications.

2.2.3 Data Entry Guidance

Although the existing FSAS provides some help in relation to valid entries for some fields, it is not enough and it is often too generic. The Windows-based FSAS prototype demonstrates how data entry guidance can be provided to the users. The prototype emphasizes two ways of providing guidance to the users.

1. Easy Access to User Manual Data

First, it moves frequently used data from user manuals to on-line computer files and provides users with an easy and efficient method of accessing the data in these files. For example, Figure 2.6 illustrates the activity numbers selection screen in the PTRS prototype. If the activity number is known, it can be entered directly. If it is not known, a search can be performed on a particular topic and then the appropriate activity number can be selected. This can be easily accomplished by entering the topic in the Find Next field, click on the Find Next button or by using the ALT F key combination. The subsystem will find the first occurrence of the topic and display a symbol representing a book. Clicking on the book will display the appropriate activity numbers relating to the specified topic. At this point the appropriate activity number can be selected by highlighting it and clicking on the OK button.

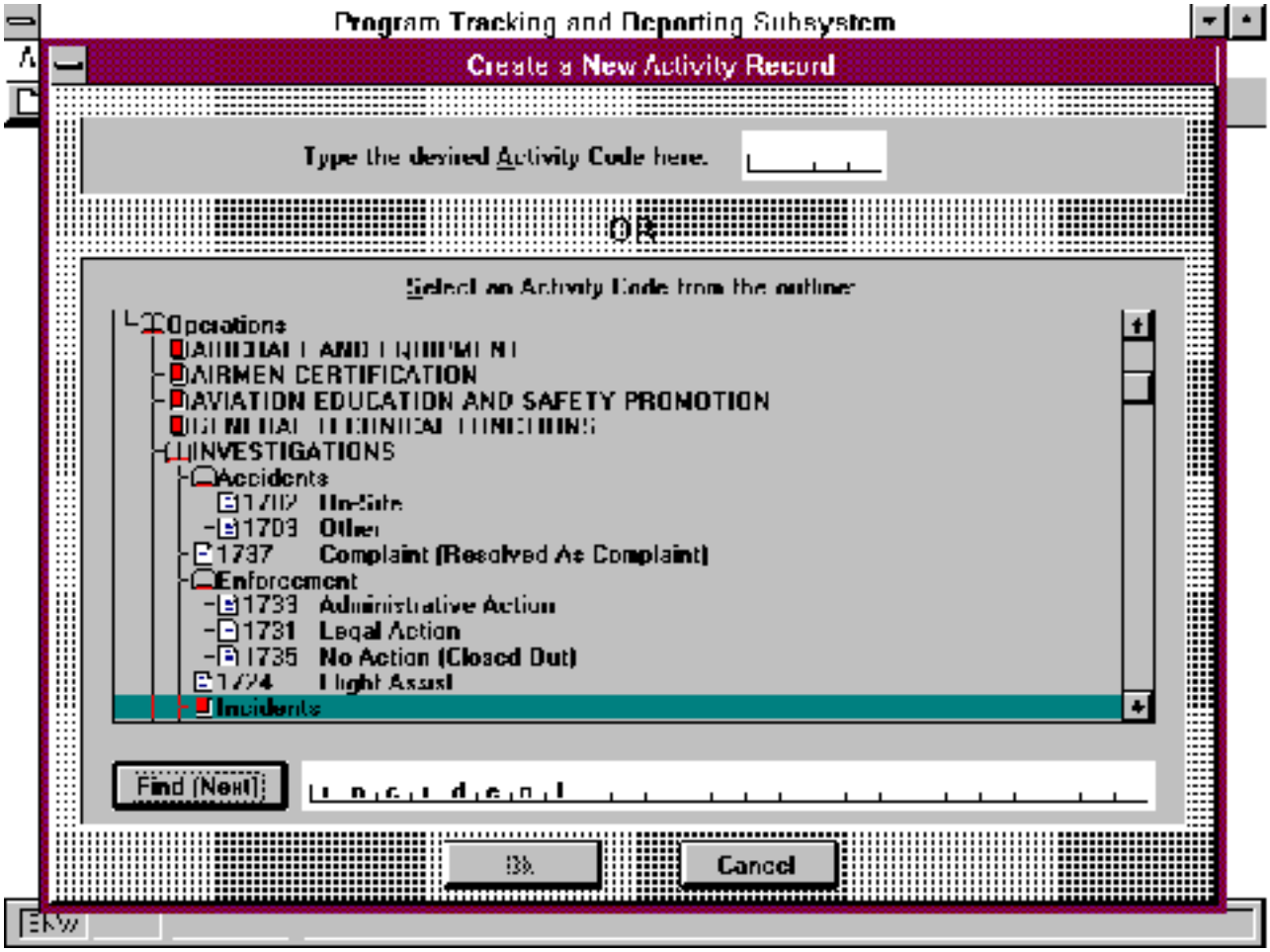


Figure 2.6 Activity Numbers Selection Screen in PTRS Prototype

2. Field Sensitive Information

Second, as the user moves to a field, a message is displayed on the bottom of the screen detailing the valid entries for that particular field. Figure 2.7 illustrates this functionality. Each field has an associated help text, so the user will always have an idea of what to do next.

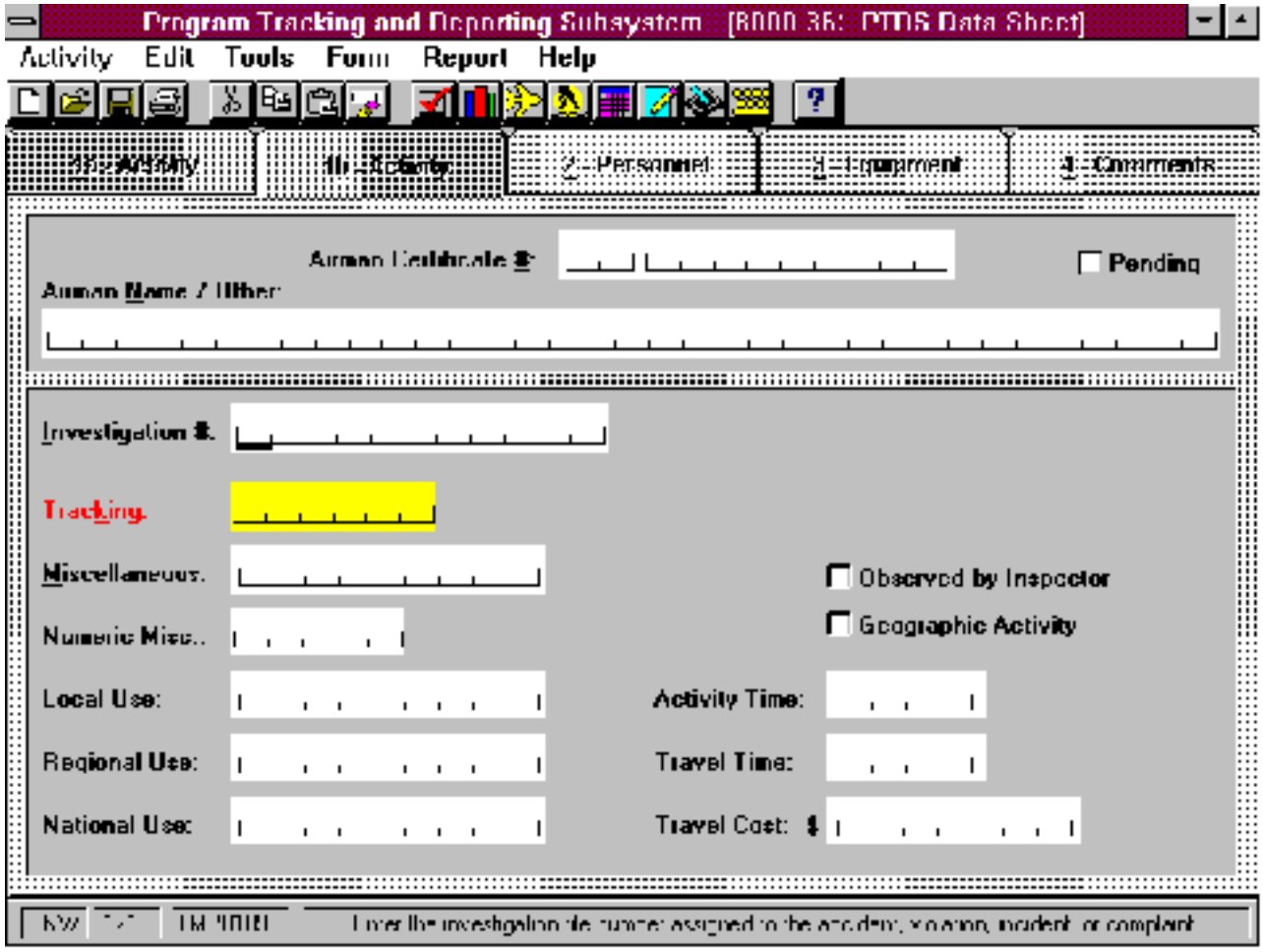


Figure 2.7 Example of Field Sensitive Functionality

2.2.4 Search Capabilities

The searching capabilities in FSAS are very limited, particularly in PTRS. In this subsystem, searching can only be done by Record ID. If a record needs to be retrieved for an update or for viewing and the Record ID is not known, a special query will have to be run by the system administrator to find the record. The prototype addresses this problem by providing search capabilities on fields that are more useful to the users. Figure 2.8 shows the PTRS search screen in the prototype. A search can be done by Activity Number, Start Date, Record ID, Designator and NPG fields. In addition, a search can be done using a single field or multiple fields. This search function was originally developed in the Inspector's Field Kit. It was integrated into the prototype with minor modification.

2.2.5 Easier Access to Subsequent supporting Screens

The subsequent data entry screens for comments in the existing FSAS system are too difficult to access. In order to access these screens, a user is required to step through several intermediate screens. The FSAS prototype handles this inconvenience by allowing access to all subsequent screens from any screen. Figure 2.7 illustrates this functionality. On the top of the each screen there are five tabs (1a Activity, 1b Activity, Personnel, Equipment, and Comments). Each tab represents a separate screen in the current FSAS system. In the prototype, if access is needed only on the 1a Activity screen then on the comment screen, it will be a matter of just clicking on the appropriate tabs.

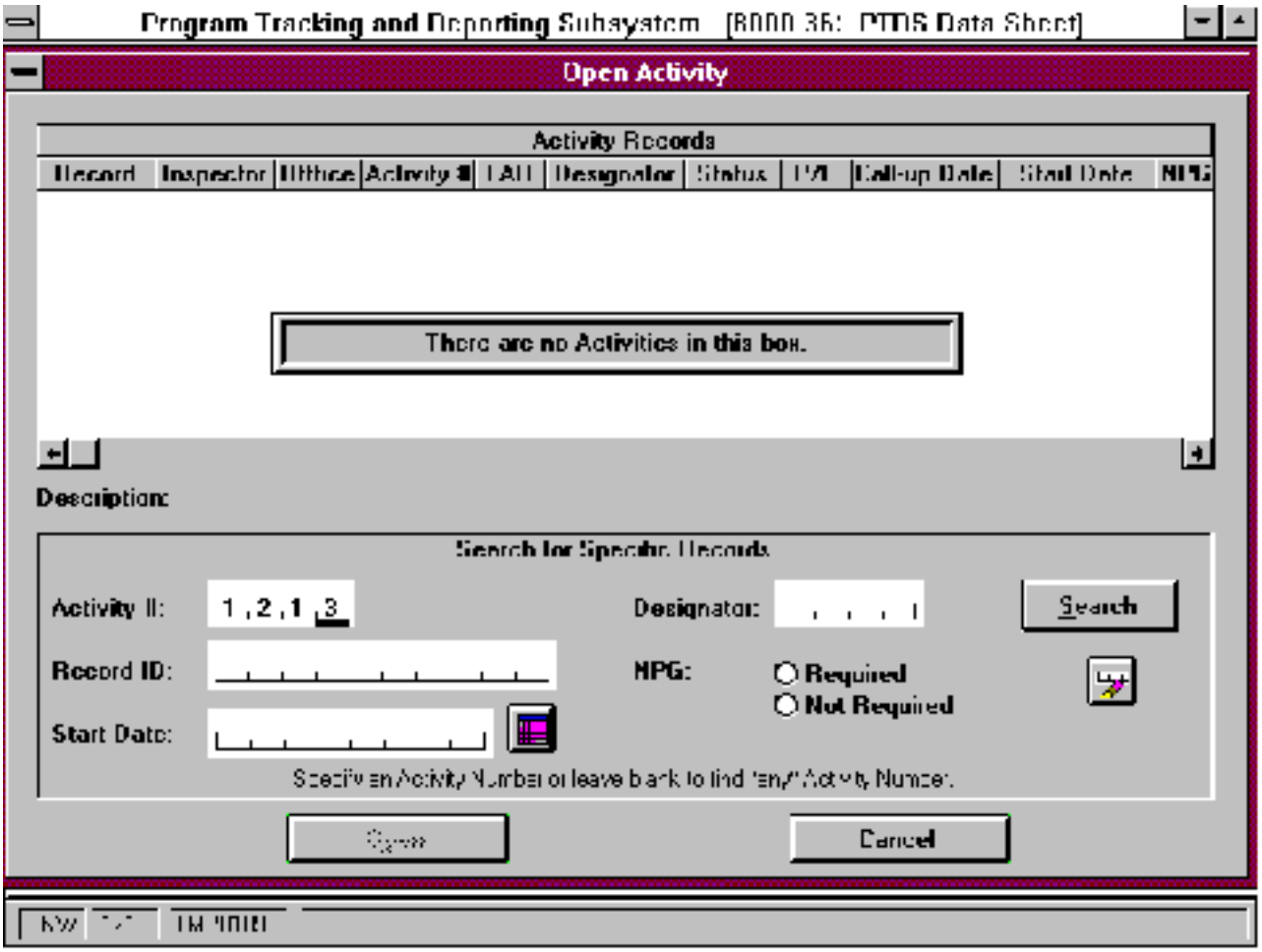


Figure 2.8 PTRS Search Screen

2.2.6 Text Editor

The Text Editor is used for entering comments. In the existing FSAS systems it is very difficult to use. One obvious inconvenience is that it splits lines within words instead of between words. Figure 2.9 depicts a text editor resident in the FSAS prototype which provides most of the functionality of a word processor. It allows users to cut, copy and paste text within or across systems. In addition, it splits lines in the appropriate place.

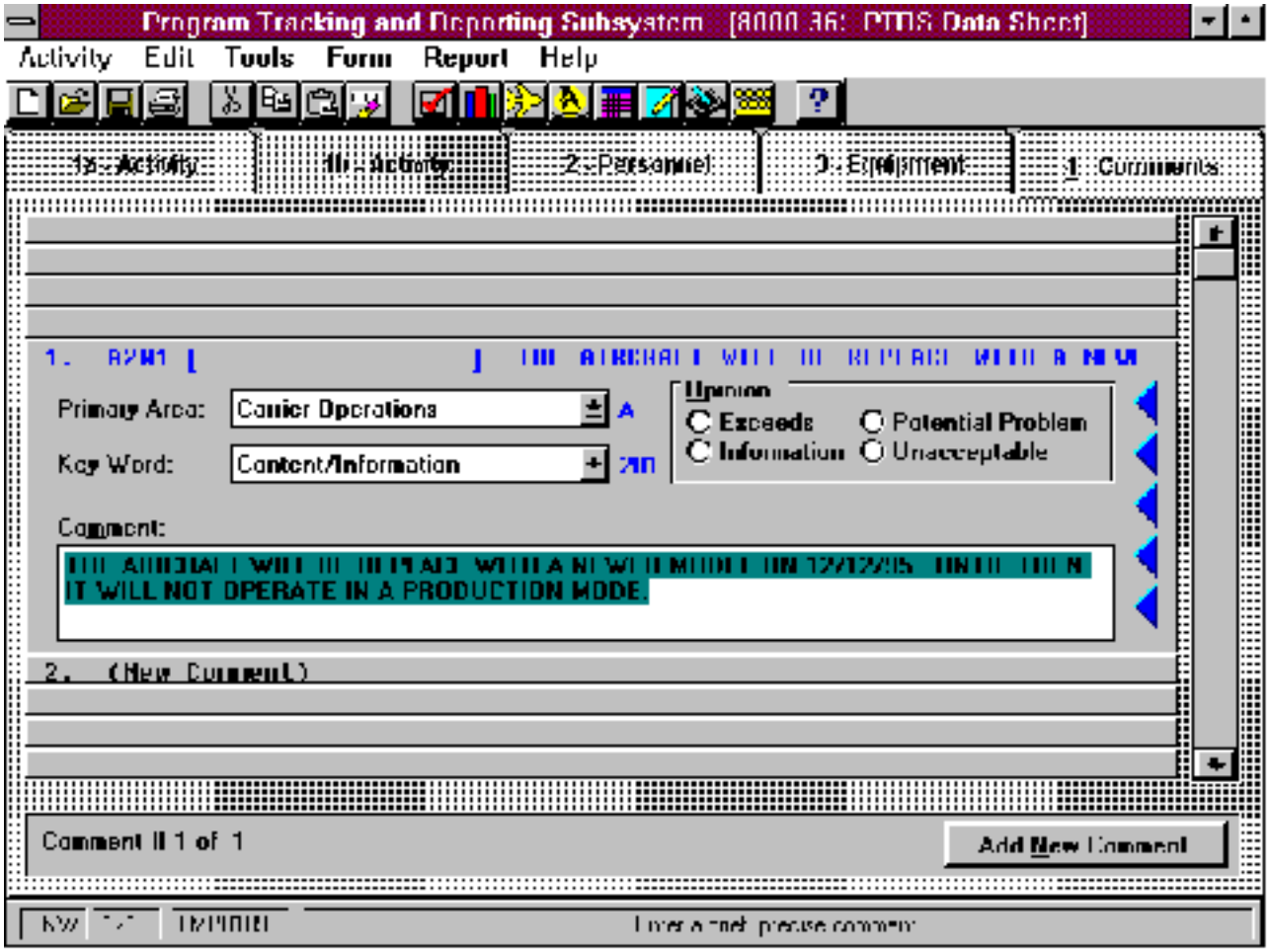


Figure 2.9 Duplicate Data Entry

2.2.6.1 Duplicate Data Entry

The ASIs log the majority of their daily tasks into PTRS. However, there are several tasks that require the ASIs to enter data into multiple FSAS subsystems. The same data elements are frequently entered across these subsystems. The task of adding an air operator requires that an ASI enters the same information relating to the FAR, Designator Code and Name, and Personnel into PTRS, VIS and the Operation Specifications Subsystem (OPSS). This is very time consuming, often frustrating to the users, and it also leads to data integrity problems.

The prototype remedies this situation by allowing the user to selectively choose to transfer data between subsystems, if the task requires it. For example, if a user wants to add an air operator, he/she would first access the PTRS. Figure 2.10 shows the main startup PTRS screen. The user would then select the 'Initiate VIS' option on the PTRS startup screen because this task requires duplicate data entry across subsystems. After the user saves the information in PTRS, the VIS system is automatically started and the FAR, Designator Code and Name, and Personnel Name and Title fields in VIS will be automatically populated with the information entered in PTRS. Figures 2.11 and 2.12 show the PTRS and VIS screens with the data entered. If the user had chosen to access VIS first, the same functionality would have been available through VIS.

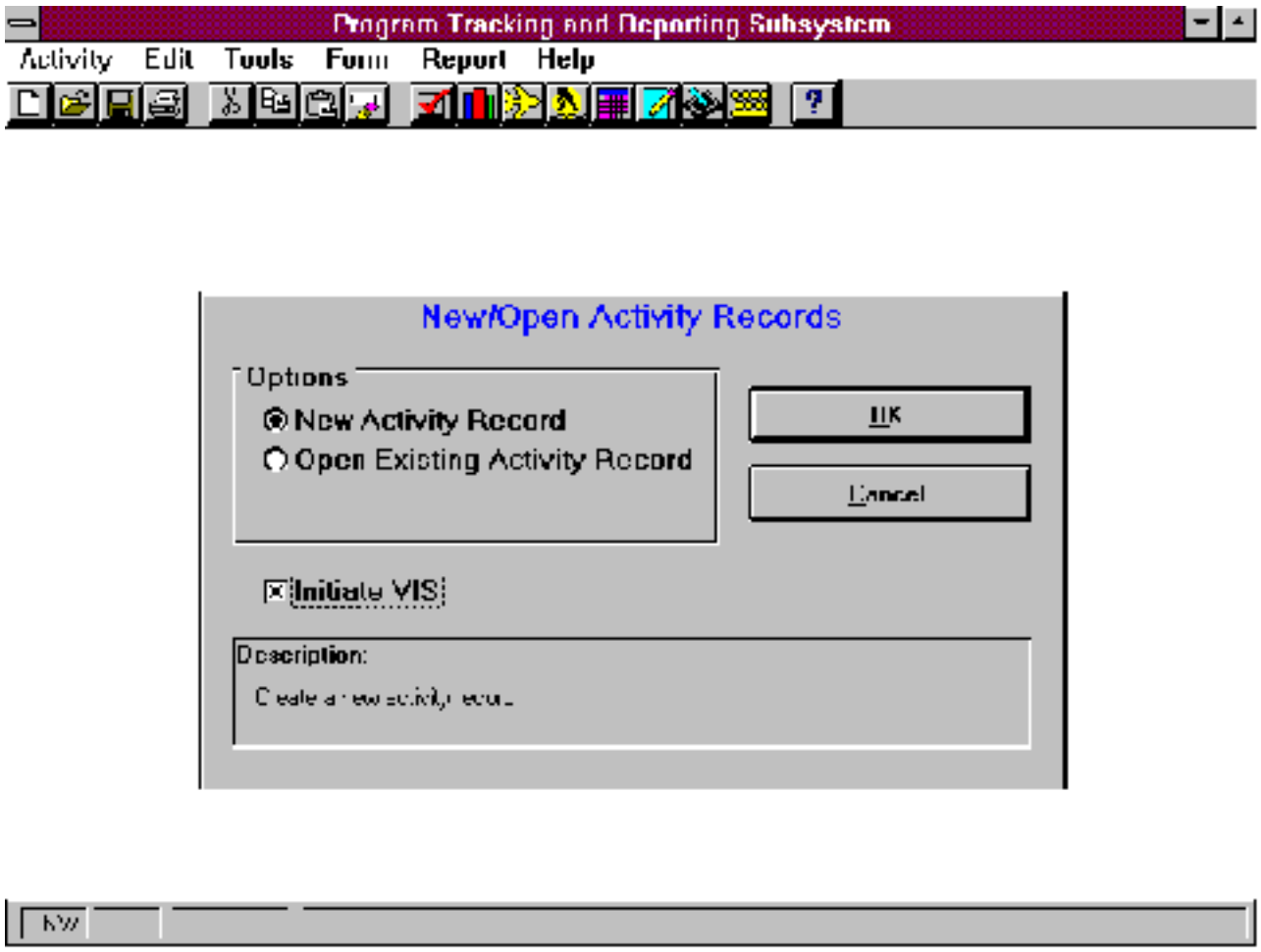


Figure 2.10 Main Startup PTRS Screen

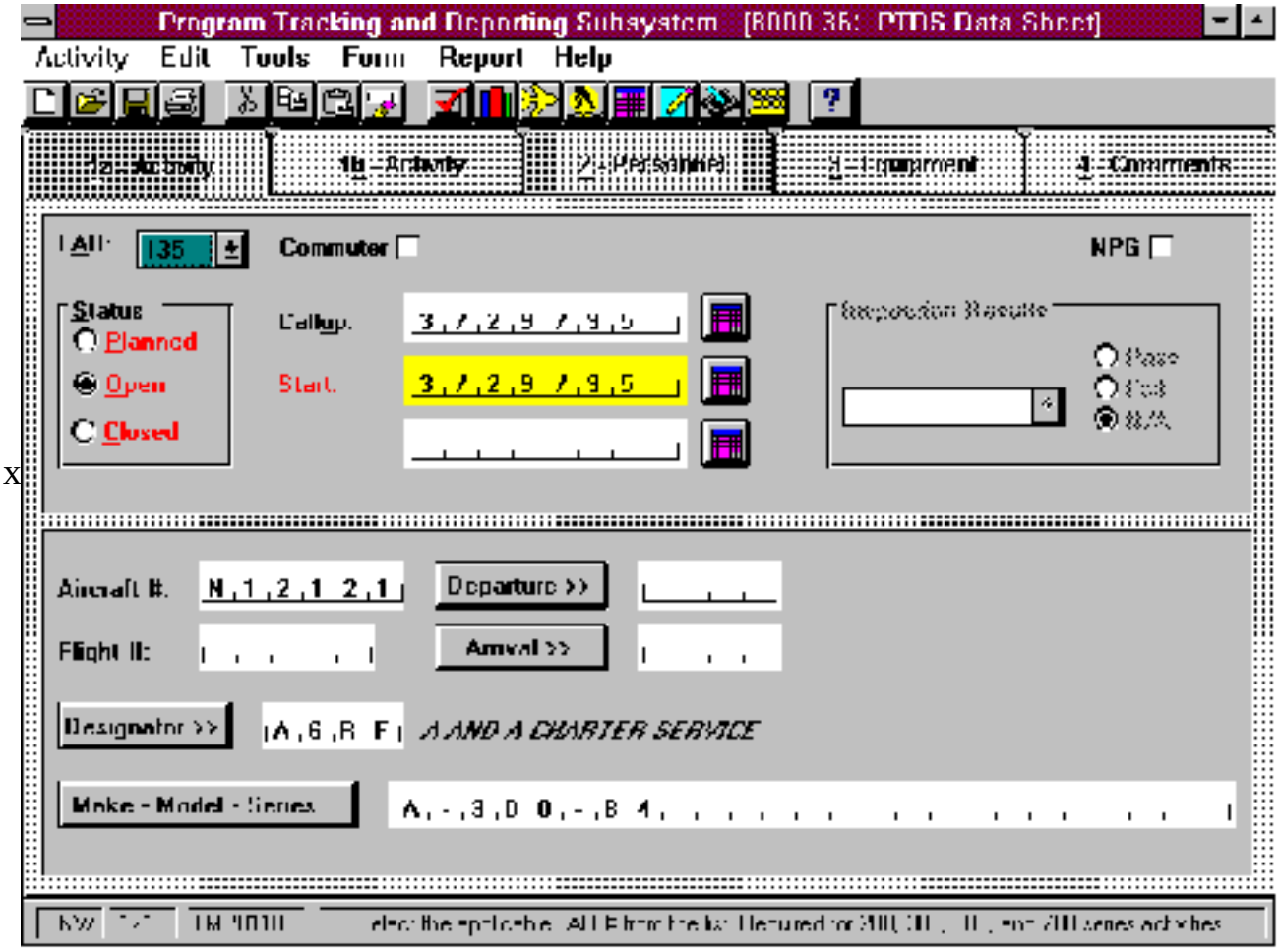


Figure 2.10 Main Startup PTRS Screen

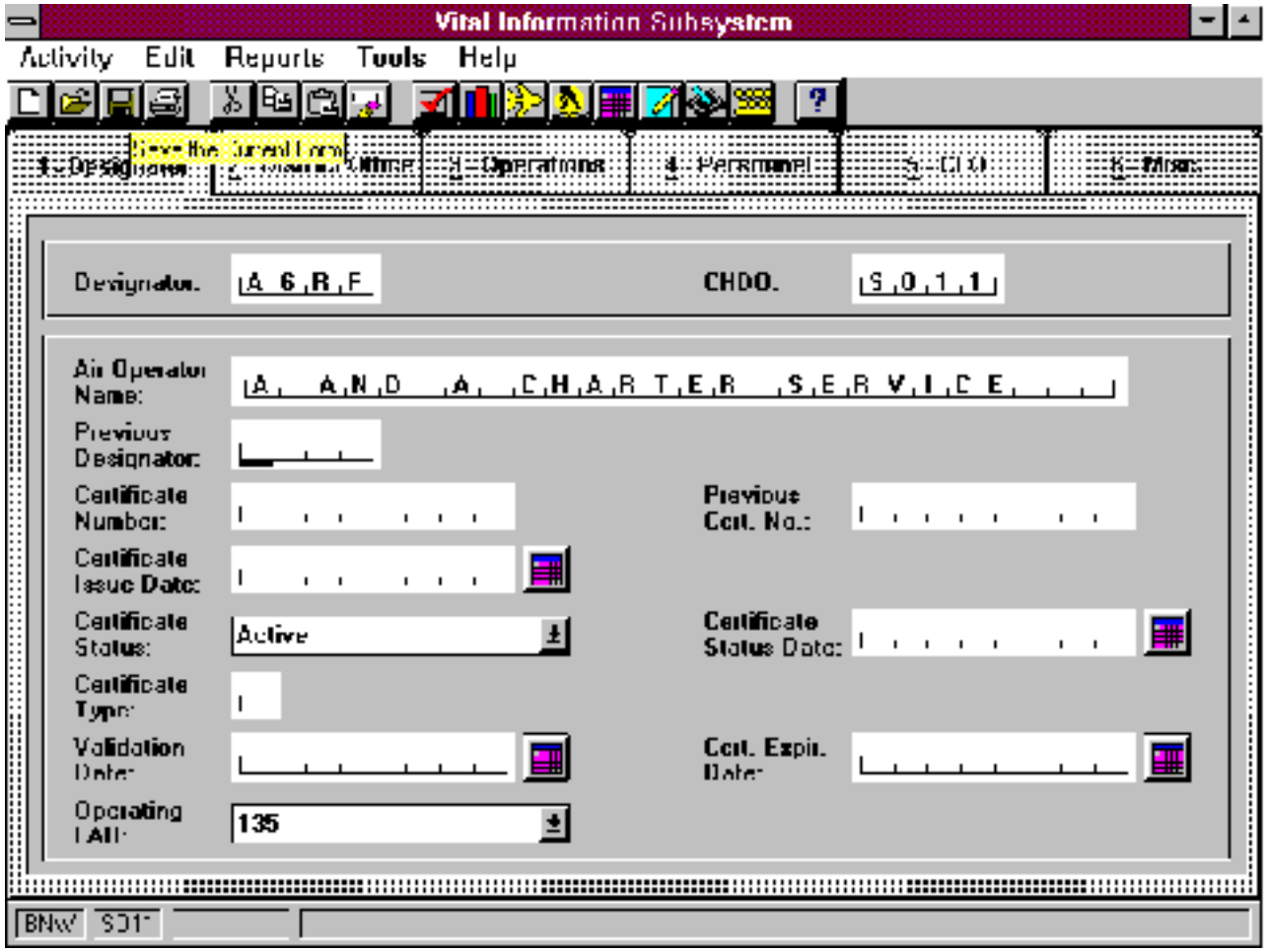


Figure 2.12 VIS Screen

2.2.7 Subsystems Integration

The prototype demonstrates how the FSAS subsystems can be more tightly integrated when running in a client/server environment with normalized databases. This allows data to be migrated from subsystem to subsystem because all subsystems will have a common source of data. The prototype also allows any subsystems to be started from within another subsystem. For example, while a user is in PTRS, he/she can access VIS or OPSS by accessing the Tools menu and then select the appropriate system. At this point the user will have multiple systems running at the same time. The user will not be required to exit the current subsystem he/she is in before accessing another subsystem.

2.2.8 Ad-hoc Reporting tools

The ad-hoc reporting function resident in the existing FSAS is extremely difficult to use. In order to effectively use the ad-hoc function, a user needs an adept knowledge of the Paradox Database system. Many ASIs like the idea of an ad-hoc function, and they indicated that they would use this feature more if it was easier to use.

As was mentioned earlier, the AFS has decided to move to a client/server environment. Therefore, we looked at several ad-hoc reporting tools that could benefit the AFS and that could be easily integrated into any Windows-based database system. These tools all run in the client/server environment. Because access to a client/server environment was not available during the investigation period, the evaluation of these tools was based on documentation retained from the various software vendors and trade journals. The following is a brief description of three reporting tools investigated as well as their relative merits to the AFS.

Crystal Reports Professional 4.0

Crystal Reports from Seagate Software Company includes a report wizard that will walk a user through the process of creating various types of reports, such as standard columnar, cross-tab, and summary reports. In many cases a user can create a report in three simple steps. First, the user chooses the type of report he/she wants. Second, the user selects the fields and drags and drops them to the appropriate place on the report formatter. Finally, the user generates the report. Crystal Reports can benefit both the developers and the end-users alike. Developers' data dictionaries can be created, which store pointers to the databases and connection types that are used most frequently. The dictionaries could be passed on to the users, and let the users run ad-hoc reports without having to understand complicated table relationships and data types. Crystal Reports also has an excellent charting tool that provides users with the capability to view data in a graphical form.

ReportSmith for Windows 2.5

ReportSmith by Borland International Inc. is very similar in terms of functionality to Crystal Reports. However, ReportSmith is the fastest reporting tool of the three. It also provides a more extensive and flexible field criteria selection box. Therefore, very complex reports can be generated without any programming effort. Like Crystal Reports, fields can be placed on the report formatter by dragging and dropping them to the proper location. However, ReportSmith automatically calculates the best fit for the report and lays out the data on the screen accordingly. The users' ability to manipulate the report design is far better than any of the other two products. It also contains an integrated charting tool, which allows a user to view data graphically.

R&R Report Writer 6.0

R&R Report Writer by Concentric Data Systems Inc. was the most difficult to use of the three products. It was a bit difficult to select the fields a user wanted on a report in R&R. Unlike the other packages, there was no way to select all the fields at once to place them on the report formatter. The report formatter in R&R is the weakest of the three, providing only the traditional banded-style-report design tool. This formatter is very similar to the one in the current FSAS ad-hoc reporting system. R&R Report Writer does not provide an integrated charting tool. To create a graph, a user would have to export the data into a software package that supports graphics, such as Microsoft Excel.

Crystal Report and ReportSmith are two reporting tools that can definitely benefit the AFS users. These tools run in the Windows-based client/server environment and will allow users to generate ad-hoc reports by simply selecting the type of report, the necessary fields, and then generating the report. Prior knowledge of a programming language or database structures is not required. These reporting tools can effectively hide the complexity of table relationships and data types from users. Users are able to extract data from the database in the form of a report or graph without being concerned about where and how the data is stored.

2.3 Inspector's Handbook Multi-Media Prototype

There is a tremendous amount of information contained in the Inspector's Handbooks utilized by the ASIs. The ASIs currently use a paper version of these documents to assist them in performing their duties. Recently, versions of these handbooks have been produced in digitized form and distributed on CD-ROM. These digitized handbooks have several time-saving features such as word/phrase search, linking, and database navigation functions.

Flight Standards Service (AFS) aviation safety inspectors (ASIs) can increase their productivity by being provided with a tool to quickly and comprehensively access information contained in the Inspectors Handbooks. Such information serves as reference material and basic guidelines to the ASIs. A prototype of the Inspectors Handbook software was developed to address this need. This prototype incorporated several time-saving features such as word/phrase search, document linking, and efficient navigation. Multimedia technology was integrated into the software to provide the inspectors with a subjective evaluation in situations where traditional methods of instruction fail.

This task challenged the research team to determine if the ASIs could benefit from the intelligent integration of multimedia technology (primarily video and audio) in the handbooks, and if so, how it would best be implemented.

2.3.1 Requirements Definition

There are many factors to be considered in creating a multimedia-inspectors handbook. First, the system must be fully useable and understandable to the aviation safety inspector. This will be insured with a user-centered design approach: capitalizing on rapid prototyping and interactive development driven by user evaluation and feedback. Second, the system must be developed on computer technology that is compatible with FAA's current and evolving systems. This will be ensured by working closely with the Training and Automation Committee, and with other FAA research projects like PENS. Third, the multimedia information system should be easily modified to incorporate updates and document evolution. This will be insured by the use of commercial off-the-shelf software development tools.

Presently the ASIs have a choice of either carrying the handbooks with them in the field or leaving them behind. If the ASIs carry the handbooks with them, they find the handbooks are bulky and cumbersome to carry. The ASIs must then sift through large amounts of information. It is a mammoth task to search for something unless the location is specifically known. Cross-referencing documents also becomes a major problem. Another option is to leave the handbooks behind and just look up the information needed before leaving the office. This is not always possible. In such situations, the ASIs could jot down the information required and return to the office to look it up. This approach leads to inefficiency and delays as the information is not available on hand to look up. This could present a problem in certain situations where time is of the essence, for example in a ramp inspection situation. The ASIs would then rely on their past knowledge or experience which may not be up to date with the most recent revision of the handbooks.

Current multimedia technology can be used to deliver the Inspectors Handbook on-line, complete with an efficient searching function and hyperlinks between relevant documents. This will reduce the ASIs physical and mental workload. The integration of multimedia features also has the potential to provide refresher training and/or initial training based on an individual inspector's need. The entire software could be put onto a portable notebook computer equipped with a CD-ROM which the ASIs could carry with them on the field. This way the ASIs would have instant access to the most current handbook information. This would enable them to perform their tasks more efficiently.

Through a series of meetings and discussions with ASIs, it was determined that the most promising application of multimedia information technology would be in support of tasks where the ASIs are required to make qualitative judgments based upon visual observations. Less experienced ASIs and all ASIs who perform some type of visual assessment could benefit from an on-line video or graphic to aid them in their decision-making process. Another promising application of this technology is to provide background or tutorial information concerning a complex or detailed issue.

2.3.2 Methodology

The Inspectors Handbook software prototype was developed using the principles of human-centered design. The tasks of the ASIs were first analyzed. During interviews with the ASIs, several observations were made as to how the handbooks were actually used by the inspectors. The following is a list of ASIs' activities observed and how handbooks were used:

- Looking for a specific reference by either using the Table of Contents to look up a specific chapter and/or browsing throughout the document looking for related information.
- Placing bookmarks at useful or frequently referenced sections in the document.
- Annotating a specific paragraph or section.
- Referencing another document related to the topic of interest.
- Physically inserting related reference documents in the handbook at appropriate locations.
- Comparing change notices with the old version of the document to determine what has changed and how it effects their activities.

The above observations revealed the need for developing a computer based software which would aid the ASIs in their day to day tasks. This entailed putting the Inspectors Handbooks on-line with various features such as search, hyperlinks, and multimedia which would help the ASIs navigate through the handbooks. For the initial prototype, it was decided to include a subset of the Inspectors Handbooks which would serve to demonstrate the capabilities of the software. The PC platform was chosen for developmental work as it was compatible with the FAA's current and evolving systems. The necessary digital documents, figures, and videos were created and integrated to ensure a comprehensive prototype. The initial prototype was developed and shown to the ASIs to get their feedback. The prototype was then cycled through several iterations based on their suggestions. Emphasis was placed on interactive development driven by user evaluation and feedback. Different scenarios were developed and evaluated for inclusion in the prototype. The prototype was also shown to different people internally to test for usability and to debug it.

The software prototype is PC compatible. The software prototype development environment was Windows for WorkGroups 3.11 running under MS DOS 6.2. The programming was done in Visual Basic 3.0 and Borland C++ 4.0 with support from Windows SDK 3.1. Database support was provided by MS Access 2.0 and Hypermedia Information System (an internally developed database.)

2.3.3 Description

2.3.3.1 General

When the Inspectors Handbook software is started up, a screen similar to the one shown in Figure 2.13 is displayed. Handbooks 8300-10 and 8400-10 can be accessed in the prototype. By directly placing the cursor on one of the titles and selecting it will bring up the table of contents. The table of contents uses an outline type of index. For example, when the user first enters the screen, only the volumes contained within that handbook are displayed. Selecting a particular volume by moving the mouse over it and clicking on it brings up the list of chapters contained within that volume as showed in Figure 2.14.

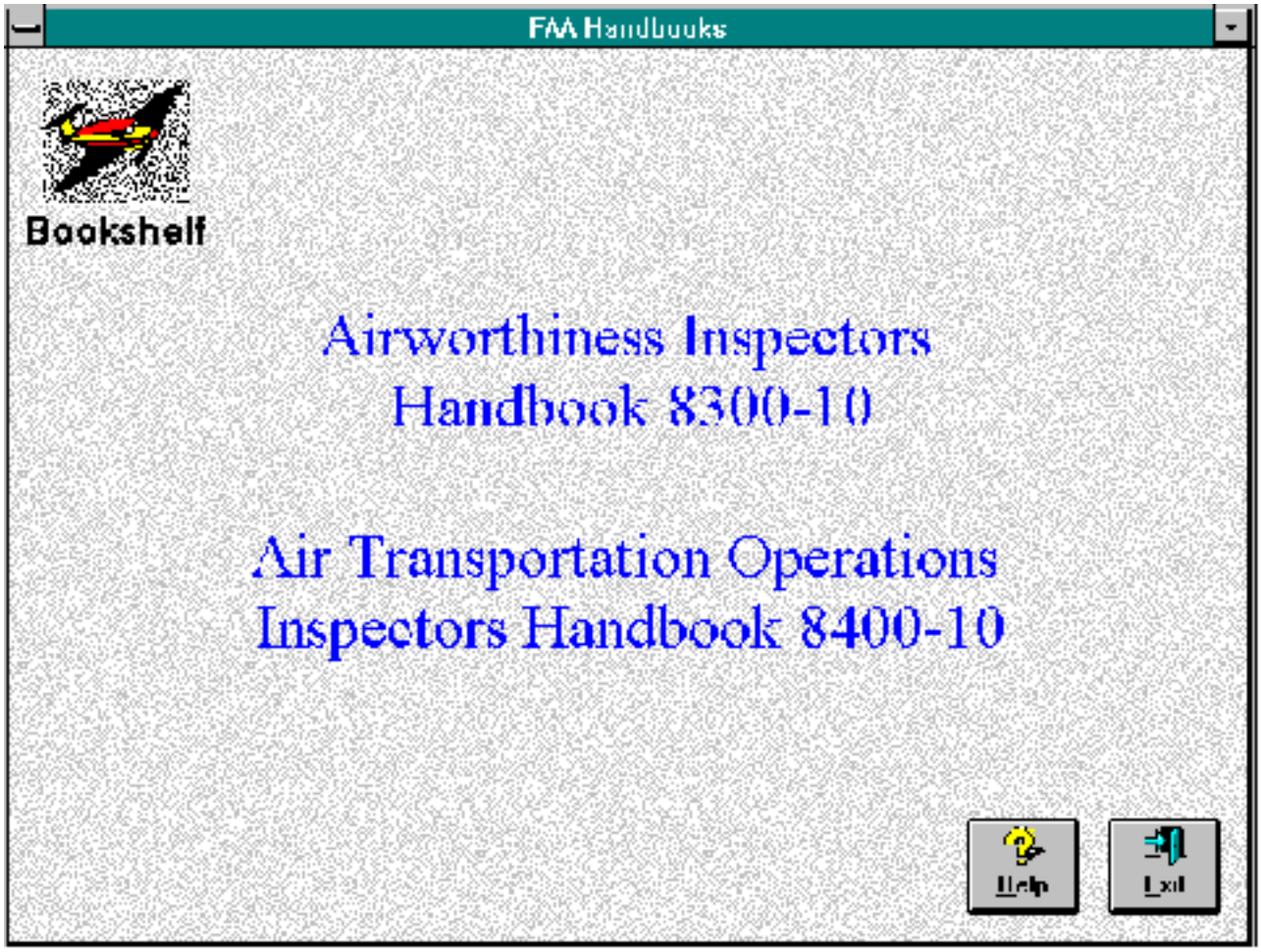


Figure 2.13 Inspectors Handbook

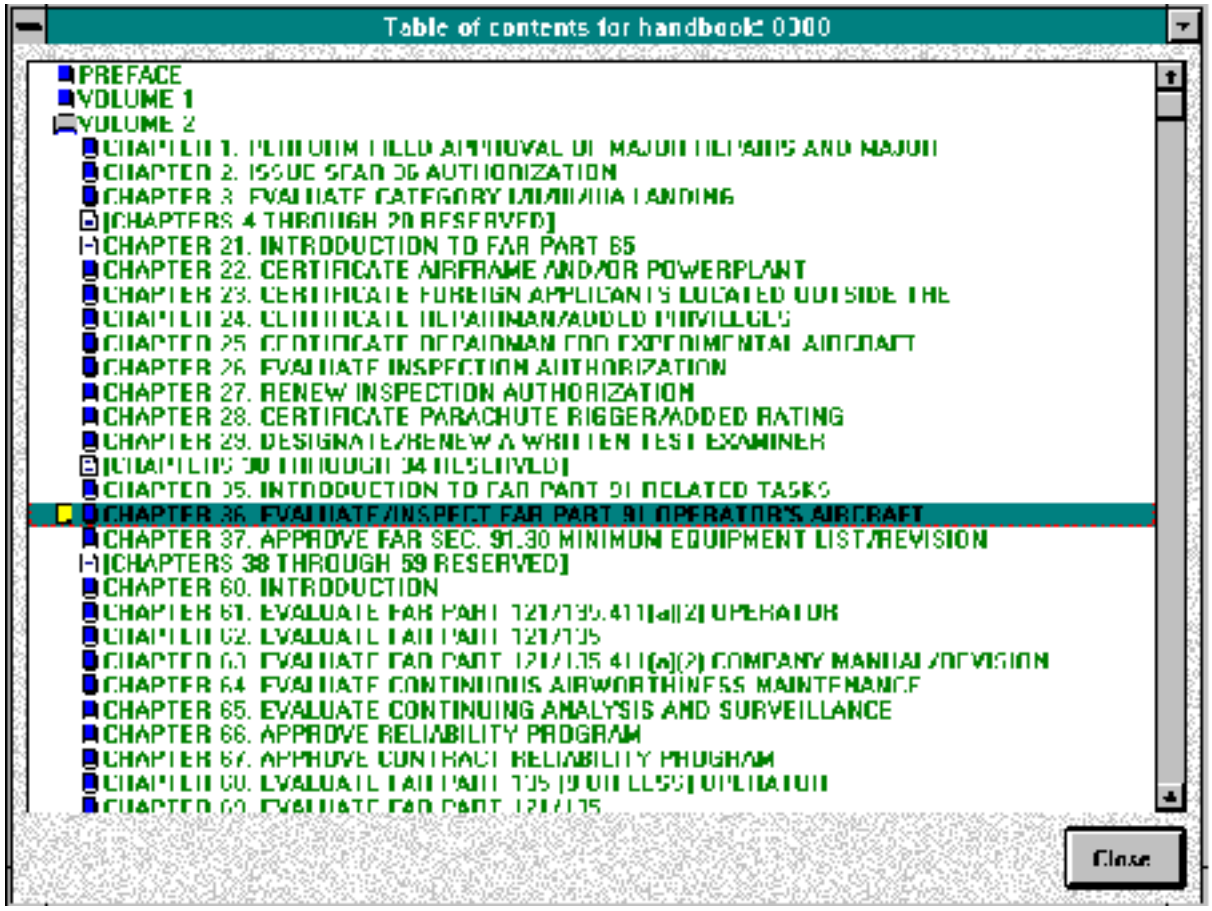
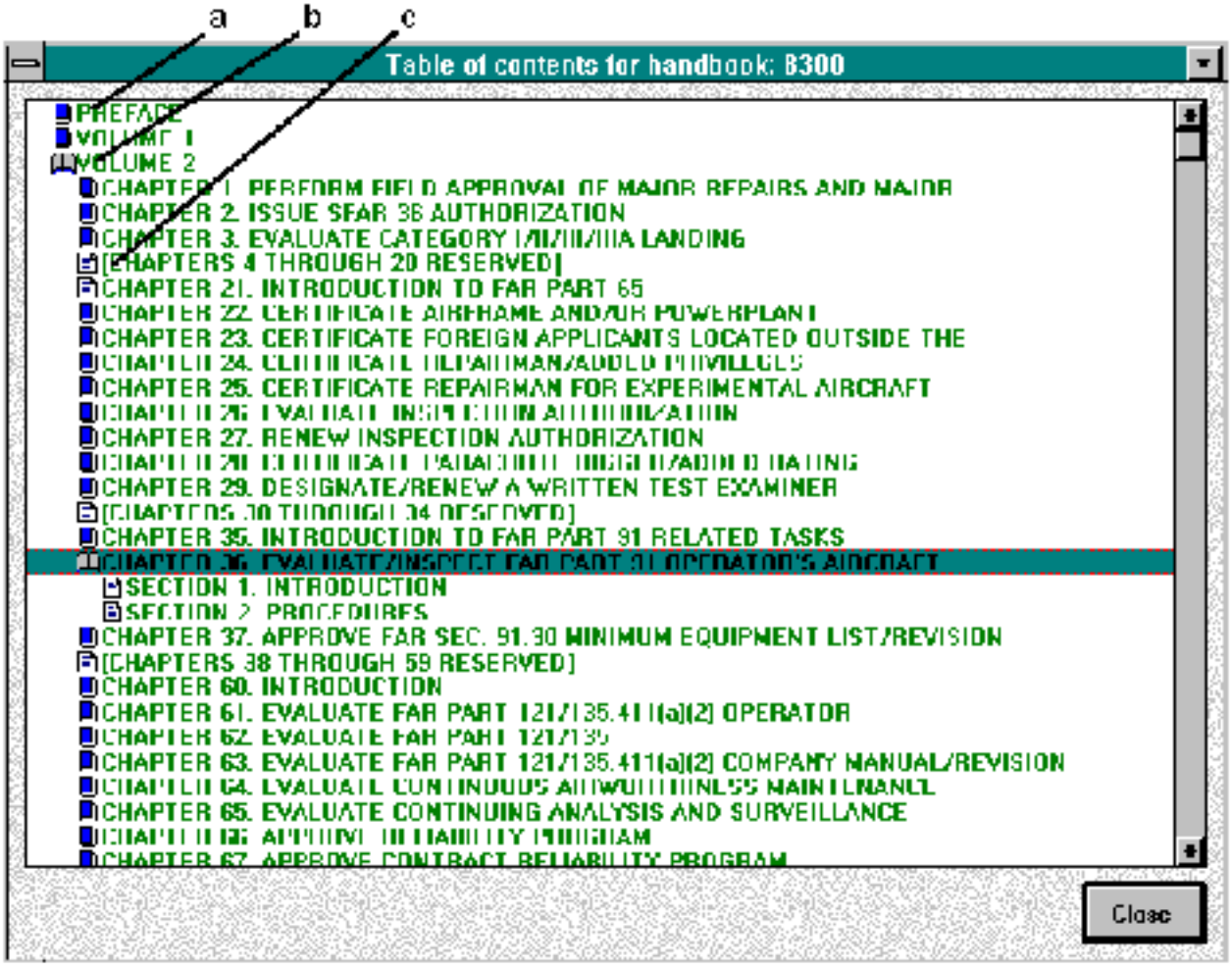


Figure 2.14 Table of Contents

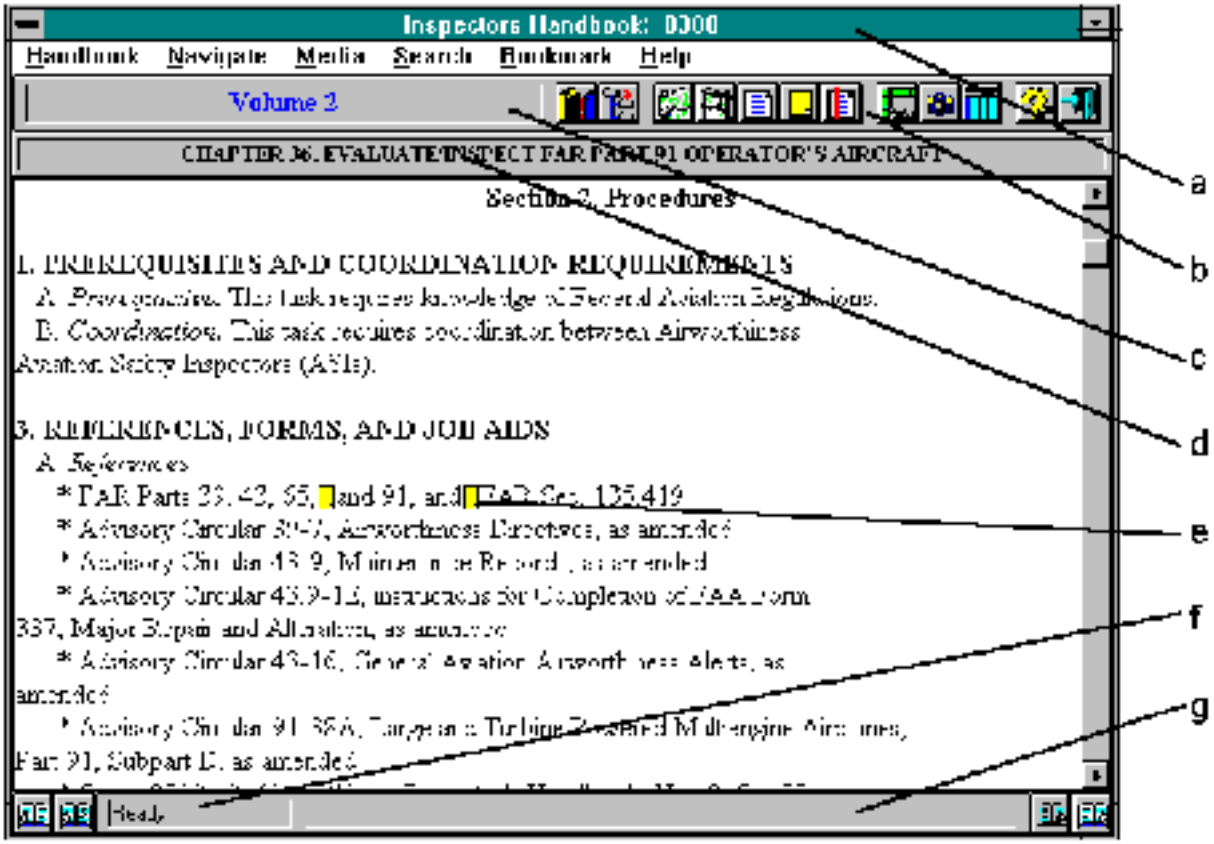
The expanded volume has an 'open book' icon associated with it which indicates that the items contained within the volume have been displayed ('b' in Figure 2.15). The other volumes have a 'closed book' icon associated with them indicating that they could be expanded to display their contents ('a' in Figure 2.15). Selecting a particular chapter brings up the list of sections contained within that chapter as shown in Figure 2.15. The section items have a 'book leaf' icon associated with them indicating that the user could select any of the section items and directly navigate to the associated text ('c' in Figure 2.15). If the user selects another volume at this time, the earlier list of chapters and sections is automatically collapsed and the new list of chapters is displayed. The icons associated with each list entry automatically change to denote the updated status of each item.

Clicking on a particular section of the Table of Contents will bring up the text related to that section as shown in Figure 2.15. The current position in the handbook is indicated by three information bars ('a', 'c', and 'd' in Figure 2.17, which display the current handbook name, the current volume number, and the current chapter number and name. The user always has access to this information which helps in navigating through the handbook. The Inspectors Handbook prototype has a fully functional toolbar ('b' in Figure 2.17,) which gives access to all the features contained within the software.



a - closed book icon
b - open book icon
c - leaf icon

Figure 2.15 Expanded Table of Contents



a - Handbook Title
b - Toolbar
c - Volume Number
d - Chapter Number
e - Annotation icon
f - Application status bar
g - Status bar

Figure 2.17 Handbook Information Screen

The expanded figure of the toolbar shows all the buttons contained in the toolbar (Figure 2.16) The 'Inspectors Handbook Bookshelf' button can be used to access a different handbook. The 'Table of Contents' button displays the complete break up of the current handbook. The 'Find' button is used to display the search dialog box. The 'Find Again' button is used to find a particular search term again. The 'History' button can be used to return to a previously navigated document. The 'Annotations' button brings up a list of the annotations for the current chapter. The 'Bookmark' button allows insertion/ deletion of bookmarks. The 'Video Player' button brings up the video player along with a list of available videos. The 'Figure Viewer' button brings up the figure viewer along with a list of available figures. The 'Table Viewer' button is similar to the 'Figure Viewer' button. The 'Help' button brings up the help topics for the Inspectors Handbook prototype (not yet developed.) The 'Exits' button closes the application.

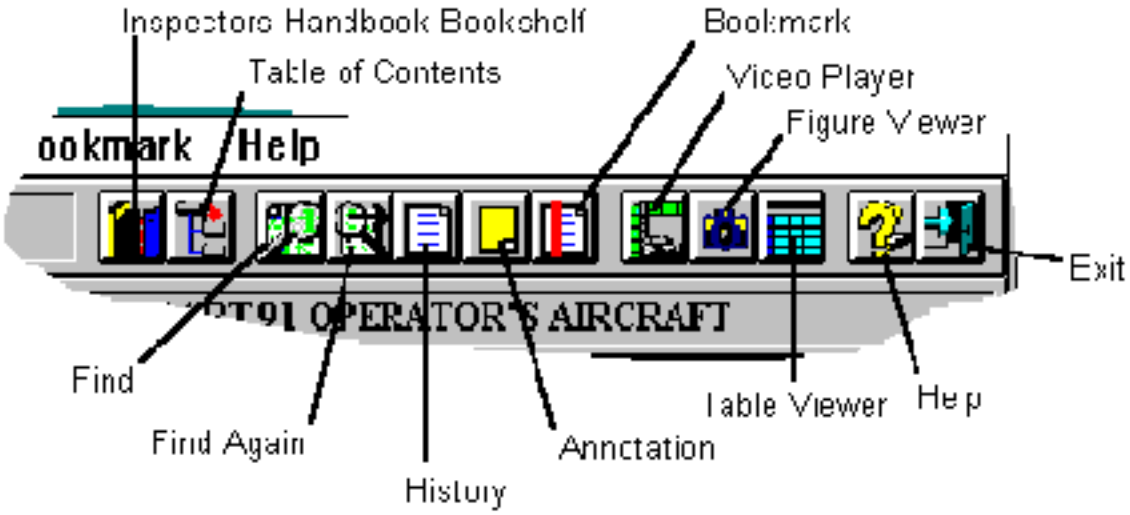


Figure 2.16 Toolbar Functions

2.3.3.2 Multimedia Information

Many of the tasks performed by the Airworthiness ASIs are visual in nature, such as looking for signs of corrosion, physical damage, and incomplete or improperly performed maintenance actions. Supplemental multimedia information would assist in such activities if they are new to an inspector or performed infrequently. Another use of multimedia information would be in providing training/refresher courses.

For example, the Inspectors Handbook prototype has video clips on corrosion which explain the corrosion process and describe the common areas where corrosion occurs. These clips could help a new ASI in learning more about corrosion. An ASI inspecting the landing gear of a particular aircraft may need more information about the procedures involved. The video clips related to landing gear information could be brought up on screen and the video clip related to the aircraft being examined could be played. These video clips would assist the ASIs in their inspection task.

Video Player: The video player (Figure 2.18) allows playback of video clips related to a particular section in the document. The list of video clips is automatically selected based on the current document context. For example, if the user selected a video hyperlink describing corrosion, only the videos related to corrosion would be displayed in the list box. The time counter shows the elapsed time.

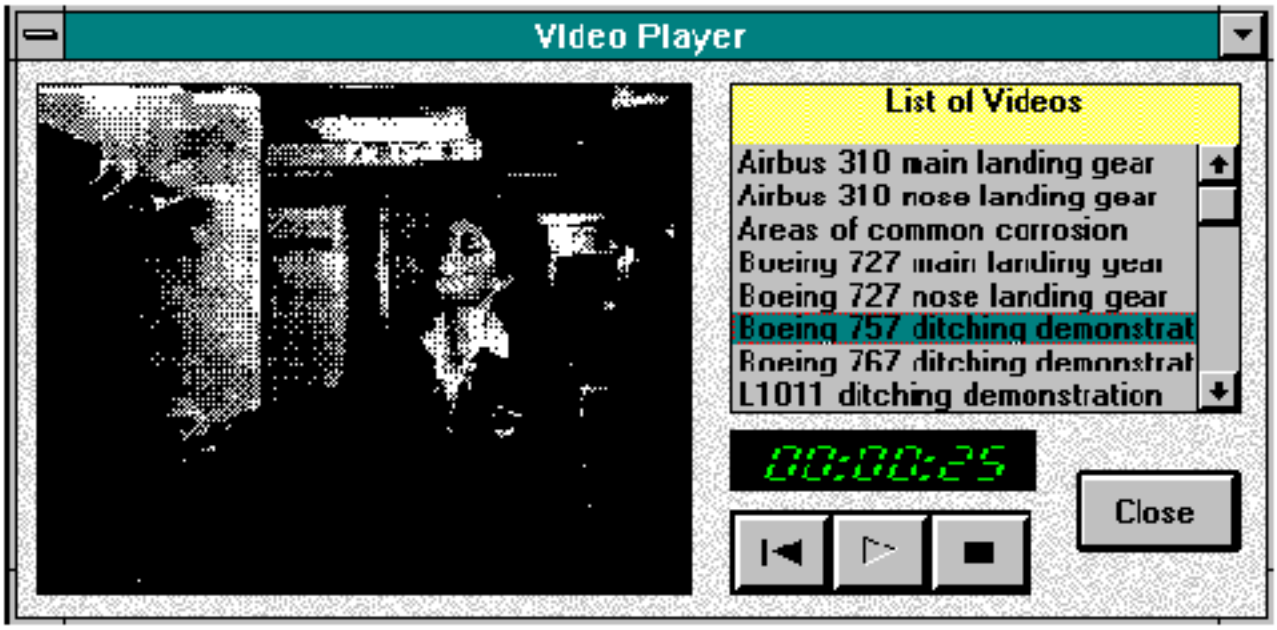


Figure 2.18 Video Player

Similarly, graphics or pictures may provide more information than words alone. For example, the severity of tire tread wear could be easily determined by comparing the acceptable tire tread wear photographs with the actual wear. This acceptable tire tread wear photographs could be easily accessed from the Inspectors Handbook software using the 'Figure Viewer' (Figure 2.19).

Figure Viewer: The figure viewer control (Figure 2.19) has the capability to display 'bmp', 'gif', and 'pcx' format pictures. The picture control has a zoom range of 1% to 999%. Selecting a figure hyperlink starts up the picture viewer and automatically loads up the relevant picture.

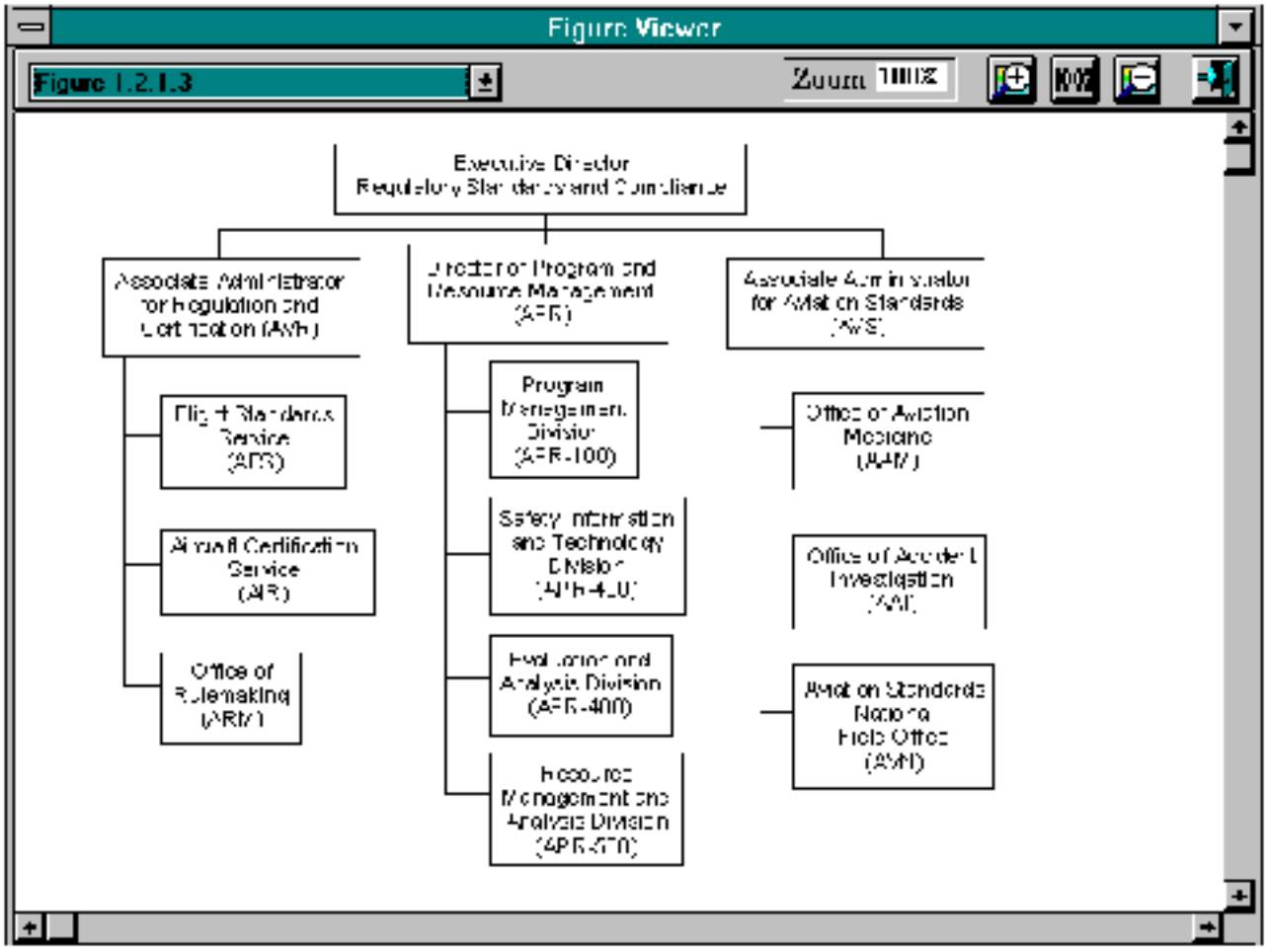


Figure 2.19 Figure Viewer

2.3.3.3 Software Specific Features

Hyperlinks: Three different types of hyperlinks have been implemented in this software. They are text hyperlinks, figure hyperlinks and video hyperlinks. The software automatically determines the type of hyperlink and executes the corresponding actions. Text hyperlinks allow navigation between relevant documents. Figure and video hyperlinks bring up related figures and videos.

Search function: The search function (Figure 2.20) has the option of searching through the current section or through the entire book. Boolean searches are allowed in the search function. Once the list of occurrences is brought up, it is possible to directly navigate to a particular occurrence. The ASIs can again return to this window to pursue other hits from the search.

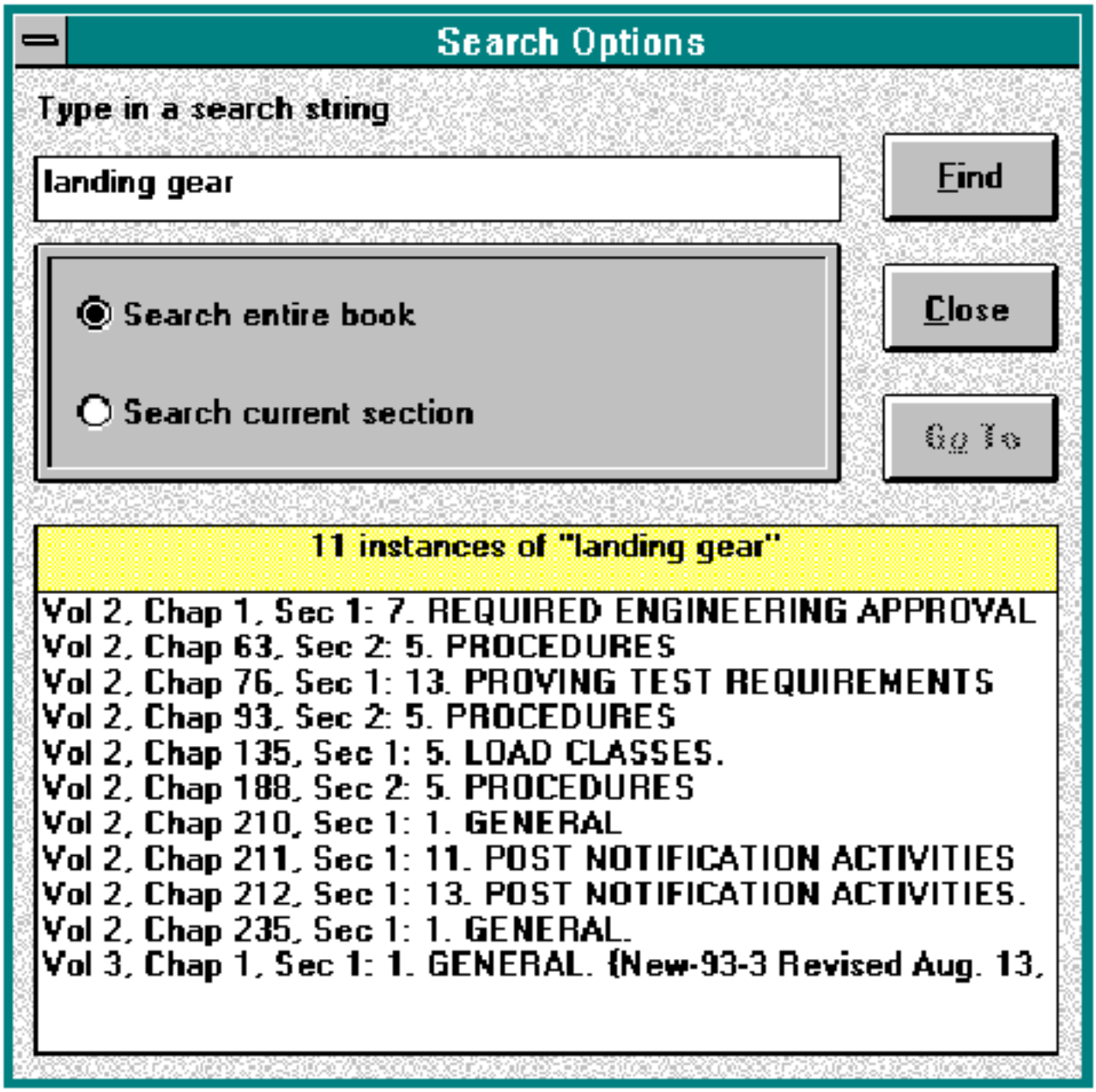


Figure 2.20 Search Function Dialog Box

History function: The history function (Figure 2.21) keeps track of user navigation through the chapter. Each section that the ASI views is recorded by this function. This facilitates an ASI in returning to a previously viewed section or switching back and forth between two or more sections.

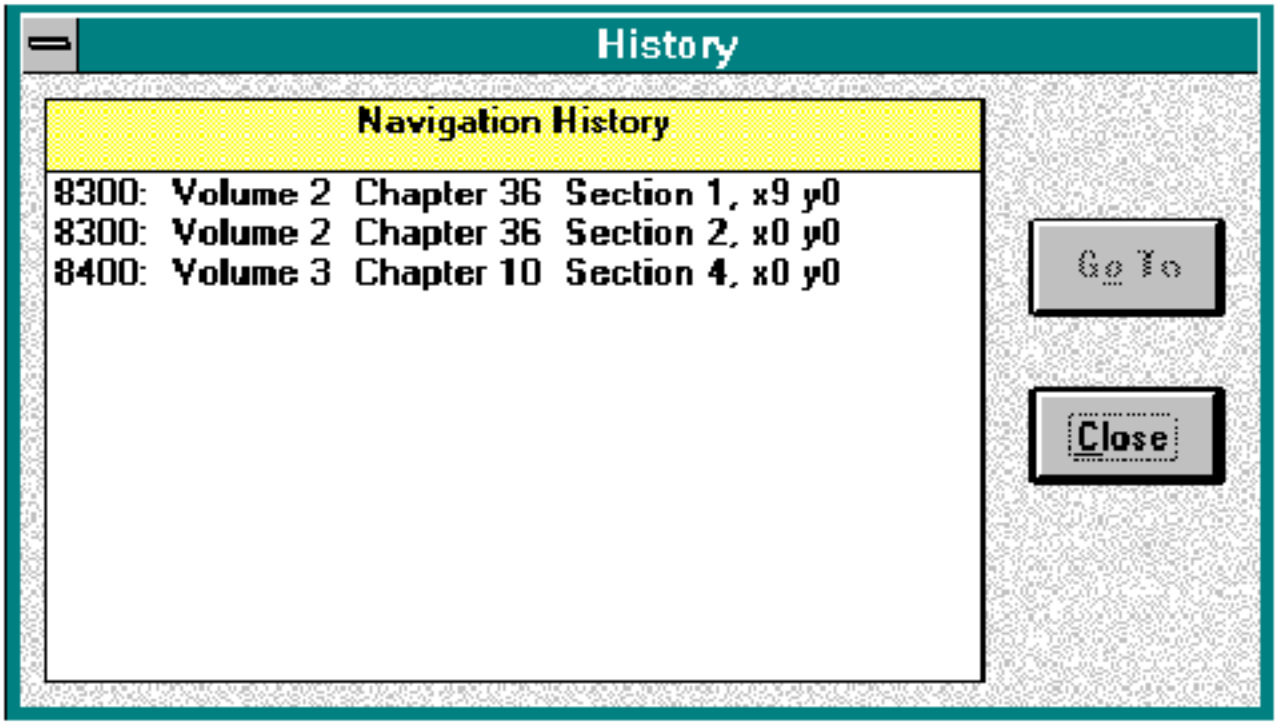


Figure 2.21 History Dialogue Box

Annotation function: The annotation function (Figure 2.22) allows users to annotate a particular section or paragraph. A small annotation icon comes up wherever the annotation is made ('e' in Figure 2.16). The table of contents is also updated to show that annotations exist for a particular chapter by putting a small icon next to the chapter title (Figure 2.23,).

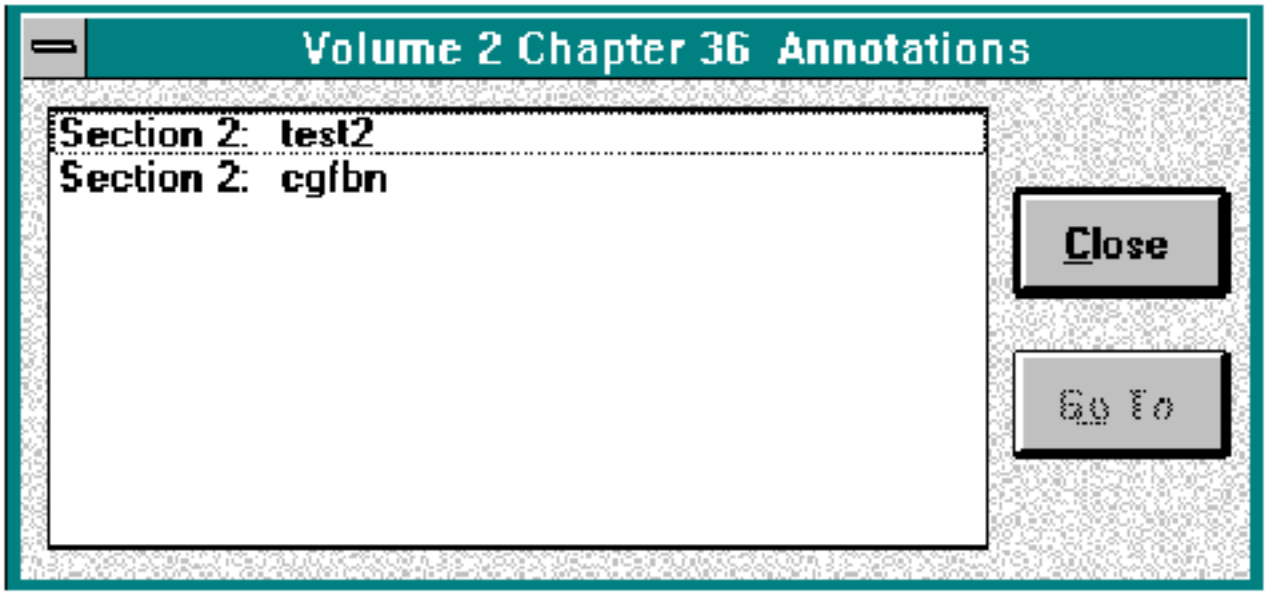


Figure 2.22 Annotations Dialog Box

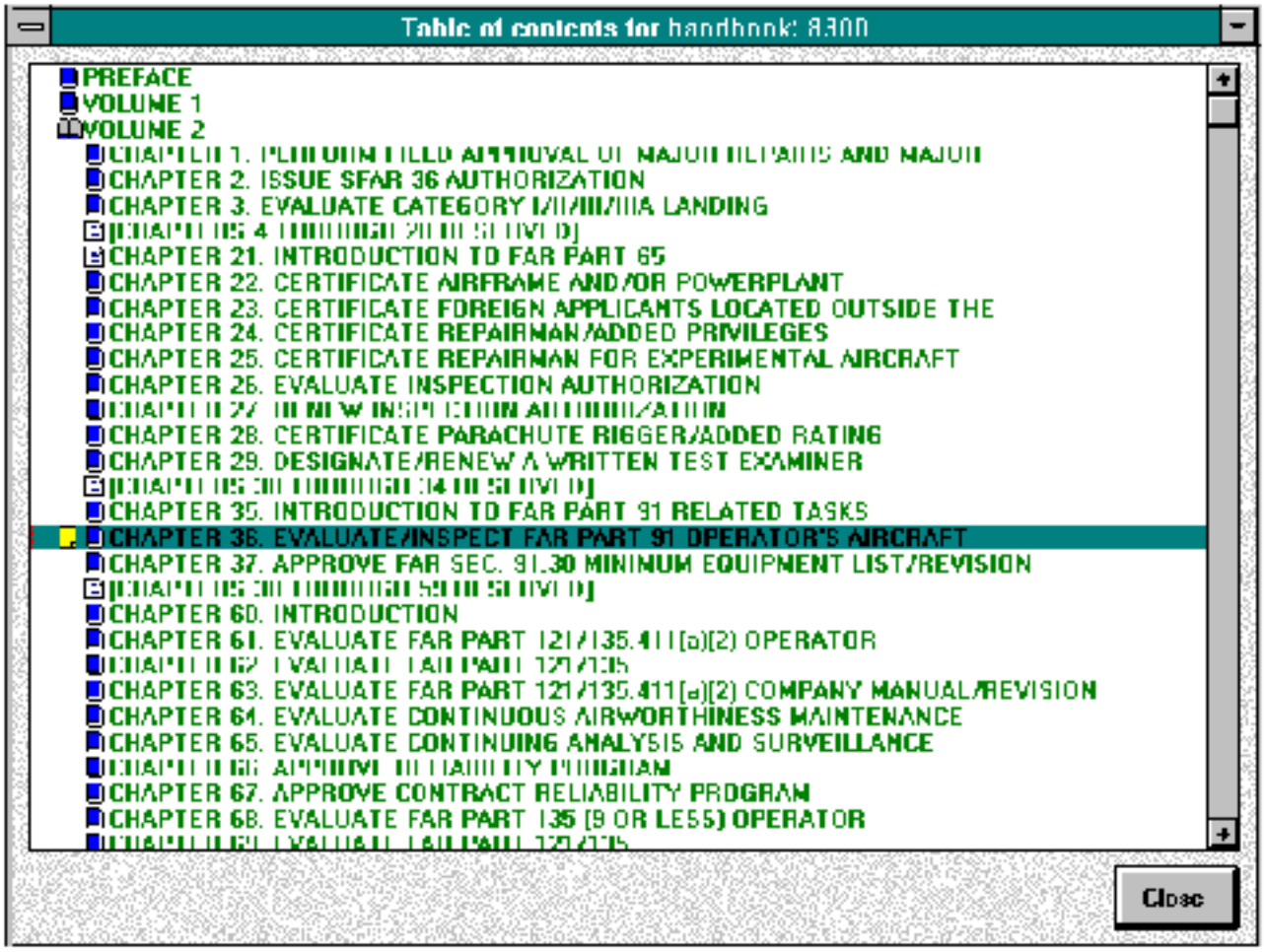


Figure 2.23 Annotation Icon in Table of Contents

Bookmark function: The bookmark function allows users to define their own bookmarks at useful or frequently referenced sections in the document. The users can access these bookmarks by selecting them from the bookmark menu item (Figure 2.24,).

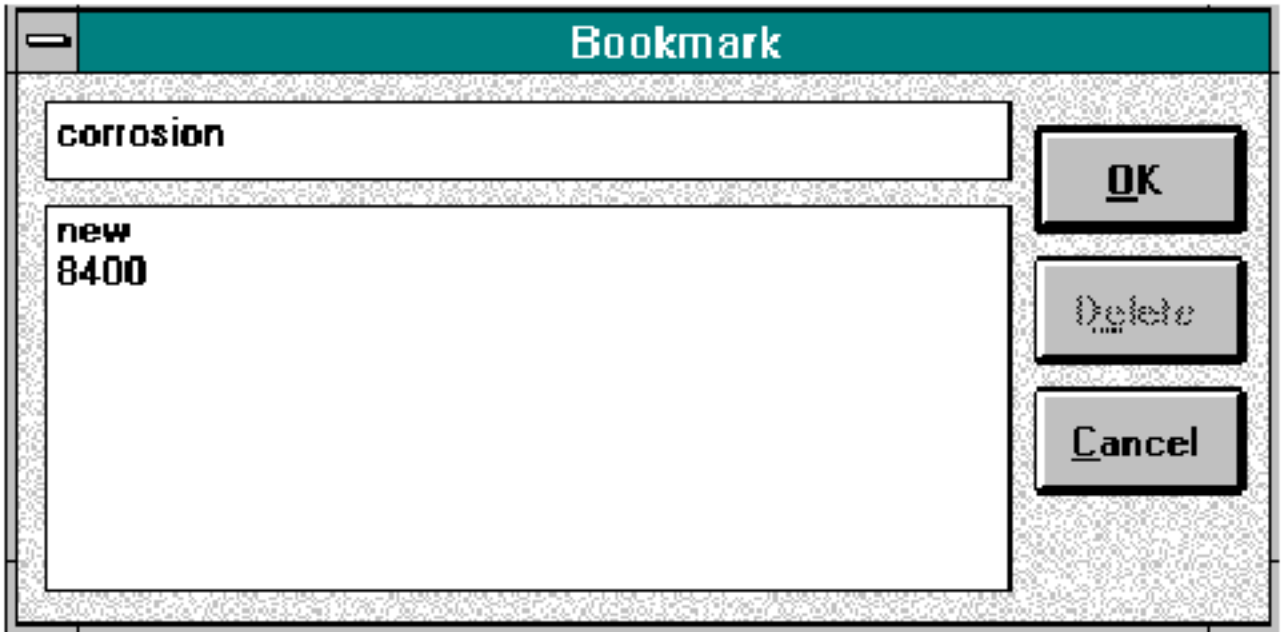


Figure 2.24 Bookmark Dialog Box

2.3.3.4 User Centered Features

To aid the ASI in using this application, a series of features were added based upon MS Windows standards and related user-centered design research.

- A toolbar complements all menu item entries for easy access to software functionality ('b' in Figure 2.16). The complete functionality of the Inspectors Handbook prototype can be accessed from the toolbar.
- A status bar displays help information for the control over which the mouse currently rests ('g' in Figure 2.16).
- Another status bar displays the status of the application, whether it is ready for user input or whether it is working on something such as a global text search ('f' in Figure 2.16).
- The cursor automatically changes to a 'hand' cursor over hot spots or hyperlinks.
- To minimize user error, all the function buttons and menu items are grayed out (disabled) if they cannot be used for a particular operation.
- If the user is about to perform an irreversible action such as deleting an annotation or exiting out of the system, the software always prompts for user confirmation.
- If an error occurs anywhere, the software always displays a message as to the nature of the error and corrective actions if any.

2.3.4 Conclusion

The Inspectors Handbook prototype would increase the productivity of the ASIs by allowing them instant access to all the necessary documents. It would cut down on the delays associated with accessing information and would make routine searches more efficient. It would further serve as a refresher/ training medium by showing relevant video footage to the ASIs if so desired.

Future enhancements to the software would include combining prototype with the Inspectors Field Kit which would allow users to fill out requisite forms and look up information at the same time. Another addition would be to link the FARs to the Inspectors Handbook prototype for enhanced information retrieval. Finally, all of the information could be accessed remotely from a central server which would help reduce the equipment carried around by the ASIs.

Future concerns include maintaining the digital handbook information current and updating the various hyperlinks within the handbooks. A suitable method needs to be developed which would automate the process of creating and updating hyperlinks from digitized data. By doing this, the ASIs would have access to the most current information at any given time.