DESIGNING ELECTRONIC PERFORMANCE SUPPORT SYSTEMS

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Abstract

Electronic Performance Support Systems (EPSS) are designed to provide information, training, and resources to users on an "on-demand" basis. This approach differs from traditional computer-based training systems in their organization, the amount of control the users maintain, and their integration with an on-the-job context.

The design of an EPSS is quite different from the design of computer-based instruction. Although an overall menu structure may exist, the user generally has a great deal of freedom to move around in the system and access specific parts. In addition, hyperlinks usually exist to connect multimedia and textual resources. This paper provides guidelines and suggestions for the design and development of electronic performance support systems for maintenance and trouble-shooting procedures.

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Introduction

During past years industry has witnessed a major change in corporate and industrial "desktops." The vast majority of employees now have ready access to computers, and the traditional "inboxes" and "outboxes" are electronic. Employees no longer have to go "down the hall" to the computer lab to complete a CBT tutorial - they have a computer right on their desk and it may be networked to all the other computers. Along with this shift in hardware availability, more powerful software programs have evolved - one of which is Electronic Performance Support Systems.

Electronic Performance Support Systems (EPSS) are integrated computer-based systems that provide access to information and training. The categories within an EPSS may include reference databases, advice, online help, computer applications, productivity software, and training (Raybould, 1990). The goal of an EPSS is to enable people with limited experience on computers to perform as if they knew what they were doing by providing all of the resources, training, and help they need at their fingertips (Gery, 1991).

Carr (1992) outlines several basic roles that a well-designed EPSS can perform:

- It can act as a librarian. In this role, it helps the performer find, organize and interpret the information required to carry out a task.
- It can function as an advisor. It embodies and shares some specialized expertise that the performer needs to carry out the task.
- It can be an instructor. In this role, it trains the performer in some aspect of the work to be done, just as the advisor role is closest to that of an expert system, the instructor role is an outgrowth of computer-based training (CBT).
- It can serve as a dofer. When in this role, it does the work with or without assistance from the human performer (p. 44).

Through these roles, employees are supported on the job with information and training "where they need it, when they need it, in the form most useful to them" (Carr, 1992, p. 44).

CBT vs. EPSS

An EPSS differs from computer-based training (CBT) in many ways. With CBT, the training is often available only by appointment in the computer lab or similar facility. In addition, CBT courses are generally conducted **prior** to a person's need. For example, an employee may attend a CBT session on how to use spreadsheets in anticipation of new job responsibilities. A problem with this approach is that, by the time the employee needs the new skill, a large percentage of the knowledge and skill will be lost on the "forgetting curve." The training component of an EPSS, however, is integrated into the employee's desktop system, along with the spreadsheets, databases, applications, etc. With an EPSS, the training is available **when** the learner needs it, reducing the

problems of retention between training and application.

Another difference between a CBT program and an EPSS is the structure. CBT lessons are generally structured in a hierarchical manner. Either the program branches the learners based on their performances, or students navigate through a series of menus to access the lesson they want. In both cases, interconnections between lesson components are limited. The structure of an EPSS, however, is built on multiple access routes and hyperlinks to other components of the system. This design permits very flexible navigation and information access by users in a nonlinear fashion. Students can access context-sensitive training from their desktops and can easily navigate between EPSS components--i.e., from a spreadsheet to online help to training.

Another difference between CBT and an EPSS is the amount of student monitoring that is available. With CBT, student activity and performance on questions and exercises is generally tracked. This tracking, however, is independent of personnel files and system records. Because an EPSS is more closely related to total employee support, the training component of an EPSS is often monitored and tracked from the system level. The integration of the training component with the system allows context-sensitive advice, information, control, and various types of support.

Benefits of an Electronic Performance Support System

Performance Support Systems are designed to support employees and to allow them to function more effectively as they learn new skills. The electronic systems can dramatically decrease the time required for an employee to master a new position (Geber, 1991). "With performance support information available at the terminal, less experienced people, with less formal training, can provide a high level of service to your customers" (Braasch, 1990, p. 23). The following benefits of EPSS technology were listed by Stone and Villachica (1993, p. 5):

- Decreases training time (20% to 50%)
- Decreases training delivery travel & personnel costs (30% to 100%)
- Increases retention (16%)
- Decreases paper documentation (33%)
- Decreases documentation reading time (20% to 40%)
- Increases productivity (25%)
- Empowers employees with the tools they need to be productive

Performance support systems can also improve the quality of products and the morale of the employees (Legent, 1993). The quality improves because the workers have ready access to support and training. With this access, the employees need less supervision and are likely to provide better service and produce better products. Employee morale improves because people are motivated with increased confidence and pride in their work.

Design of a Performance Support System

There are few established design guidelines for EPSS development. One problem is that the systems are very diverse in their applications and components (Lemmons, 1991). For example, the structure of an EPSS for trouble-shooting a helicopter may be quite different from an EPSS for an office secretary because the needs of the users vary. The following general principles, however, can be presented:

Avoid merely transferring text from paper to a computer screen. "For the system to improve performance, information must be restructured into its most usable form" (Legent, 1993). In most cases, the restructuring results in a decrease in the amount of text because the information is better organized (Raybould, 1990).

Allow multiple retrieval techniques. The user interface of performance systems should enable users to access information quickly through a variety of avenues. For example, a hierarchical menu structure may be complemented by an interactive system map and keyword searches.

Provide visual aids to inform users of their location. Maps, tables, and titles can help users ascertain their position in a system and minimize disorientation (Whiteside & Whiteside, 1992).

Employ instructional design expertise. One of the best ways to ensure that sound design principles are incorporated into an EPSS is to develop it with an instructional designer on the team (Cluskey, 1992).

Case Study

Analysis

Analysis & Technology was presented a requirement to provide support for intermediate level (I-level) maintenance technicians of the A/N37U-1 Mine Clearing Set. There are a small number of technicians and most are not computer literate; therefore, the support equipment needed to be easy to use and be accessible on the shop floor. Additionally, the system was required to provide electronic access to technical documentation (using current electronic versions), training on maintenance procedures as needed to perform each job, access to illustrated parts break-down information, and a job aid to guide performance on an "as required" basis.

The recommended solution was to design and develop a performance support system that integrates all of the required components in a moveable ruggedized cart. The following sections describe the approach taken.

Design

The user interface design is an intuitive icon-based approach that supports easy access to all elements of the system. Within each element, a hypermedia approach was used to link related information. The hyperlinking capabilities of the PSS provide alternate access to information that can help the maintenance technician perform his job efficiently. From each step of a procedure, a user can access the specific technical information on the current step form the technical manual, Illustrated Parts Breakdown information, or a training lesson on how to perform the procedure. Once in a procedure, associated notes, cautions and warnings are provided with audio narration of the precaution, along with accompanying text on the screen, and a prompt to view the technical manual when necessary. This avoids the traditional hierarchical computer-based training approach and allows the system user to access only the needed information at the required time during job performance.

The main menu (Figure 1) offers three main system components for the user - Job Aid, Training, and the Illustrated Parts Breakdown. Other selections from the main menu include a How To Use System Tutorial, Help and Exit. Clearly defined icons on the left side of the screen depict each selection.

The main system component, the job aid, is designed to assist the I-level maintenance technician as he performs procedures associated with component assembly repair, maintenance, and troubleshooting of the equipment. The job aid graphically depicts each procedure. If the maintenance technician knows that a specific subassembly is malfunctioning, he may select that subassembly from the submenu.

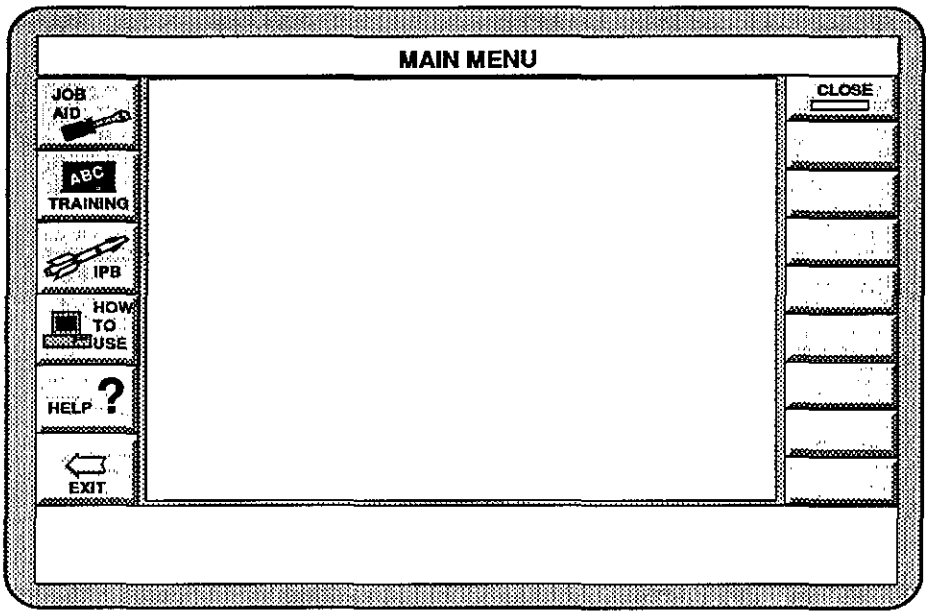

Figure 1.

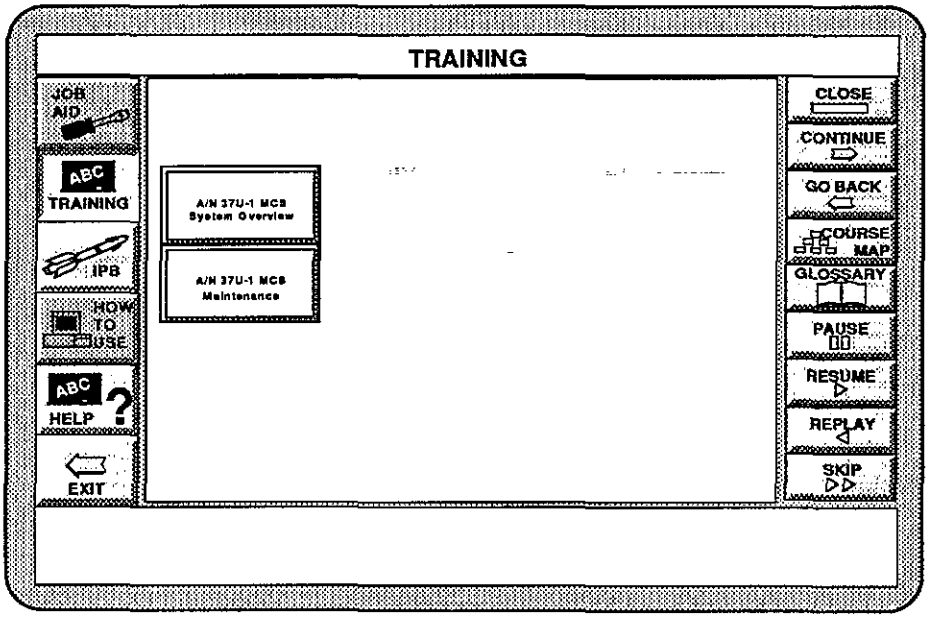

Figure 2.

Once in the job aid, navigation icons illuminate on the right side of the screen offering different options to the user. A tech manual icon provides instant access to the technical manual at the exact location of the step being performed. A glossary is available and the print function will print the job aid flow diagram or the technical manual information, if necessary. When the video icon is selected, video is played that shows the step being performed by a technician. When video is being played, video control options illuminate so that the user can pause, resume, replay or skip a video segment.

The second major system component is training. Training may be selected in two ways in the PSS system. When training is selected from the main menu (Figure 2), training is offered in a traditional CBT (computer-based training) format. The user can select lessons from a submenu and proceed through the desired lessons. When training is selected from within a step of the job-aid, a walk-through of that step of the procedure is depicted .

Illustrated Parts Breakdown (IPB)

Access to parts information is at the heart of the illustrated parts breakdown component. When the IPB is selected from the main menu, a submenu of the equipment assemblies is presented. When the assembly or subassembly is chosen, an Autocad drawing of the assembly appears (Figure 3). The IPB may also be accessed from a step of a job aid procedure. In this case the IPB icon hyperlinks the user to the assembly associated with the step. The navigation icons on the right side of the screen allow the user to manipulate the drawing by panning right or left, moving the image up or down, and zooming in or out. The textual IPB information (Government Standards, vendor, part numbers, descriptions, attaching parts, and SM&R codes) required to order parts appears in the bottom portion of the screen. This textual information, which is presented in the exact hierarchical format of the technical manual, automatically links to the part numbers depicted on the drawing or the text may be scrolled to access a different part. In addition, a specific part may be accessed through the use of a keypad.

Hardware/Software Configuration

The hardware configuration is a DELL 433 DE 33-MHz CPU with 12 MB RAM, utilizing an 80486 microprocessor with a 32-bit, EISA data bus, coupled with a 32-bit, EISA SCSI hard drive controller. Additional components include:

- Elographics Intelli-Touch Surface Acoustic Wave Touchscreen
- Sony LDP 1450 Lasermax Laservision Videodisc Player
- Hard Disk Drives (Internal and Removable)
- SuperVideo Windows Digital Video/Overlay Card
- SuperVideo Windows VGA Daughter Board Accelerated Graphics Card
- Mitsubishi Diamond Scan Monitor
- SoundBlaster Pro Audio Card and Personal Power Speakers
- Hewlett Packard Laserjet IIIP Printer
- Mobile Cart/Stand

IconAuthor authoring software was used to develop the PSS shell, with specific utilities written in the C language to support specific functionalities. The software operating environment is suitable for Microsoft Windows 3.1. with MS-DOS 5.0 (or better).

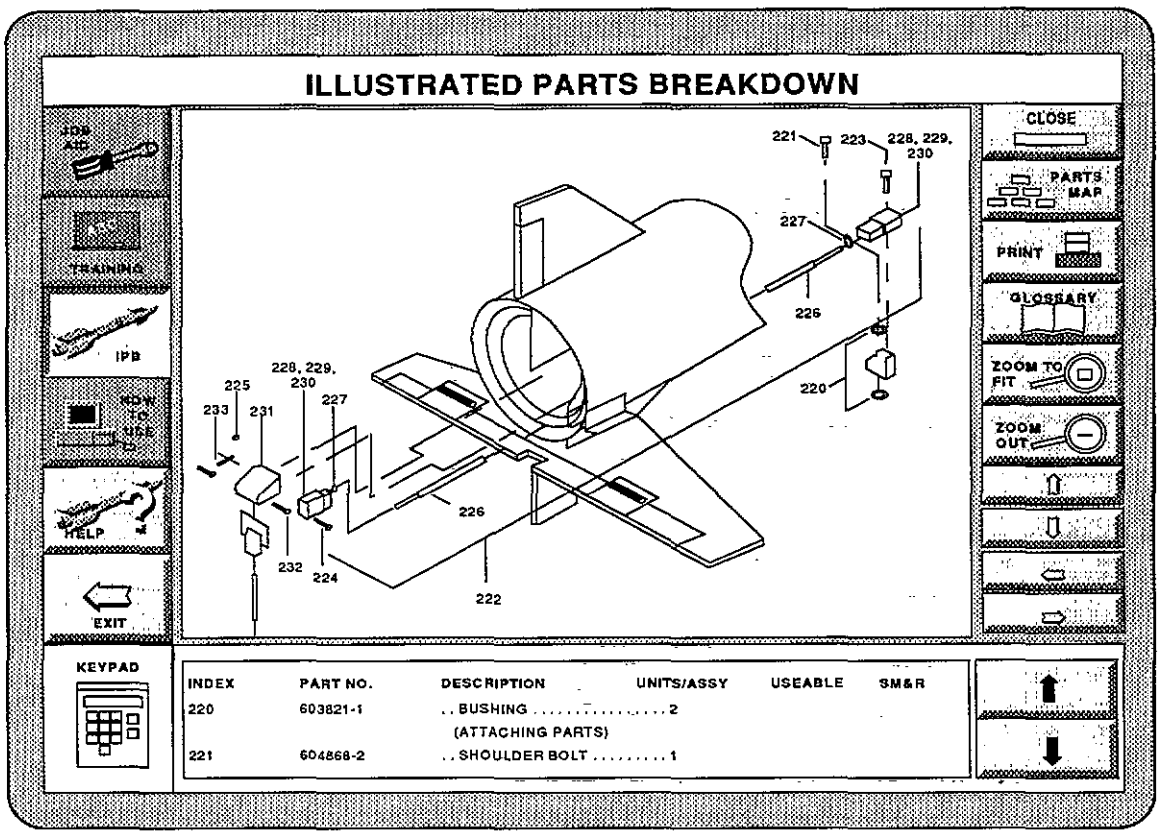

Figure 3.

Development

The PSS development spanned a twelve month period. The development process was aided by the fact that all technical manual information was provided in electronic form. In addition, the Autocad drawings were provided at project start. The development followed the traditional CBT development process, with emphasis and additional time applied to the development of the user interface and the hyperlinking options of the design. A rapid prototype of the user interface was developed by the third month of the development time frame. This allowed designers and subject matter experts to "play" with the design and make improvements early in the process. The team involved in the process consisted of three instructional designers, two programmers, a subject matter expert, two graphic artists, a word processor, an editor, and a project manager. In addition, expert government subject matter experts provided excellent input. Having the subject matter expertise available during the formative evaluation of the product was a key factor in accomplishing the development process in a relatively short time frame.

Implementation

Implementation is scheduled for fall of 1993. Implementation results and lessons learned will be presented at the 15th I/ITSEC conference.

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