DESIGNING ELECTRONIC PERFORMANCE SUPPORT SYSTEMS

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ABSTRACT

Electronic Performance Support Systems 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 the organization, the amount of control the users maintain, and the integration with an on-the-job context. The design of a PSS 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 article provides guidelines and suggestions for the design and development of electronic performance support systems for maintenance and troubleshooting procedures.

BIOGRAPHIES

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INTRODUCTION

In recent 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 computers right on their desks that are 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 (PSS).

Electronic performance support systems are computer-based systems that improve productivity by providing on-the-job integrated information, advice, and training when and where it is needed. The components of a PSS may include reference databases, expert system advisors, on-line help, computer applications, productivity software, and interactive training (Raybould, 1990). The goal of a PSS is to enable people with limited computer experience 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).

Reeves (1996, p. 1) outlines several questions you should address to determine if a PSS is appropriate in a given situation:

- Do performers have easy (better yet, constant) access to computing?
- Is the task/job that requires support complex enough to warrant an EPSS?
- How stable is the task/job? (If it changes often, an EPSS may be more appropriate than other approaches that are more difficult to maintain, change, and disseminate.)
- How critical is the task? What is the cost of non-compliance or poor performance?
- Is time available for support? (Some tasks are so time-critical that the notion of consulting an electronic performance support system is ludicrous.)
- Do performers possess the necessary characteristics to use an EPSS in terms of literacy, computer expertise, or motivation?
- Is turnover among potential users of the EPSS high? (High turnover may often justify an EPSS because an EPSS is often more readily accessible than many forms of training.)
- Are the logistics of getting people to other approaches (e.g., leader-led training) so complicated or expensive that an EPSS is a more efficient solution?
- Will the EPSS be used for empowerment of performers or to assure that they comply with specified standards of performance?
- Is the task frequently repeated? If not, an EPSS may be a sound strategy.
- Are complex decisions involved in the tasks?
- Can an EPSS be supported/maintained? How will it be updated?

The goal of a PSS is to support employees 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. PSS

A PSS differs from "traditional" 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 will be lost on the "forgetting curve." The training component of a PSS, however, is integrated into the employee's desktop system, along with the spreadsheets, databases, and other applications. With a PSS, 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 a PSS is the structure. Many CBT lessons are 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 often are limited. The structure of a PSS, however, is built on multiple access routes and hyperlinks to other components of the system. This design permits very flexible navigation and

nonlinear information access by users. Students can access context-sensitive training from their desktops and can easily navigate between PSS components (from a spreadsheet to online help to interactive training).

The evaluation components of the systems may also differ. With PSS programs, users are evaluated on their performance—rather than their ability to answer some pre-programmed posttest questions. Table 1 summarizes some of the differences between CBT and PSS systems.

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 PSS 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 PSS development. One problem is that the systems are very diverse in their applications and components (Lemmons, 1991). For example, the structure of a PSS for troubleshooting a helicopter may be quite different from a PSS for a teacher because the needs of the users vary. The following general guidelines, 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 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, keyword searches, and hyperlinks.

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 a PSS is to develop it with an instructional designer on the team (Cluskey, 1992).

Build a prototype system. Because of the potential complexity of a PSS, it is wise to build a prototype system and elicit customer feedback before proceeding with final project development.

DEVELOPMENT TOOLS

Performance support systems generally consist of four main components (Leighton, 1996):

- Applications (such as word processing, spreadsheets, and databases)
- Information bases (online reference manuals)

- Advisors (expert systems or context-sensitive help)
- Learning Experiences (tutorials and CBT)

These components can be developed through a variety of software tools, including programming languages, object-oriented languages, databases, authoring systems, expert systems, and text retrieval systems. In most cases, several of the tools are used concurrently to build a fully functional PSS (Raybould, 1995).

CASE STUDY

Analysis & Technology was recently presented a requirement to provide support for intermediate level (I-level) maintenance technicians of the A/N37U-1 Mine Clearing Set. The target audience included a small number of technicians, most of whom were not computer literate. The system was required to provide electronic access to technical documentation, training on maintenance procedures, access to illustrated parts breakdown information, and a job aid to guide performance on an "as required" basis. The recommended solution was a performance support system that could integrate all of the required components in a moveable cart and would be accessible on the shop floor. This section provides information on the design and development of the system.

The user interface design of the PSS 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 the job efficiently. From each step of a procedure, a user can access the specific technical information from the technical manual, the illustrated parts breakdown information, or a training lesson. 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. The interface avoids the traditional hierarchical computer-based training approach and allows the user to access the needed information at the required time during job performance.

The Main Menu offers three main system components for the user: (1) Job Aid, (2) Training, and (3) Illustrated Parts Breakdown (IPB). 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.

Job Aid

The Job Aid is the main system component and it is designed to assist the I-level maintenance technician as he performs procedures associated with component assembly repair, maintenance, and troubleshooting. 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.

After the user has entered the Job Aid portion of the program, navigational icons illuminate on the right side of the screen, offering additional 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. When the "Video" icon is selected, video is played to illustrate the step being performed by a technician. Whenever video is playing, video control options illuminate so that the user can pause, resume, replay, or skip a video segment.

Training

The second major system component is training. Training may be accessed in two ways in the PSS system — from the Main Menu or the Job Aid. If training is selected from the Main Menu, it is structured in a traditional CBT (computer-based training) format. The user can select lessons from a submenu and proceed through the desired lessons. If training is selected from within a step of the Job Aid, a walk-through of that particular step of the procedure is depicted.

Illustrated Parts Breakdown (IPB)

Access to parts information is at the heart of the Illustrated Parts Breakdown (IPB) component. When the IPB is selected from the Main Menu, a submenu of the equipment assemblies is presented. When an assembly or subassembly is chosen, an AutoCad drawing of the assembly appears. 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 codes) required to order parts appear 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. In addition, the text may be scrolled to locate a different part, or a specific part may be accessed through the use of an on-screen keypad.

The PSS development process spanned a twelve month period and was aided by the fact that all technical manual information was available 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.

The team involved in the development process consisted of three instructional designers, two programmers, a subject matter expert, two graphic artists, a data entry clerk, an editor, and a project manager. In addition, government subject matter experts provided input; having the subject matter expertise available during the formative evaluation of the product was a key factor in completing the development in the relatively short time frame.

SUMMARY

More and more organizations are developing performance support systems in conjunction with, or in place of, computer-based training because they can provide integrated information, advice, and training in a cost-effective manner (Dublin, 1993). In many ways, the structure and design of a PSS are different from the structure and design of a CBT lesson. This article recommends guidelines for the design of a PSS and provides an example case study for the design and development of a PSS for maintenance and troubleshooting procedures.

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