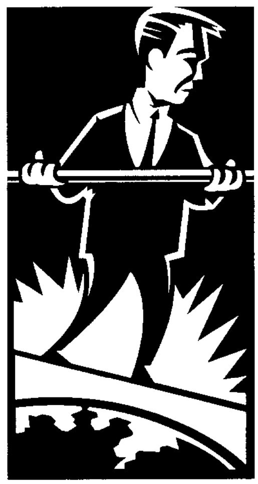
Performance Support in Perspective

by Ashok Banerji, PhD

As the new millennium draws closer we are completing one phase of information technology (IT) adoption in the workplace as well as in many other aspects of our lives. Various types of systems that have evolved for handling data and knowledge-intensive work situations fall into two broad classes: systems that provide more meaningful information to users, primarily for the purpose of decisionmaking (management information systems, decision support systems, and executive information systems), and systems that help enhance the knowledge capability of people (computer-based training, expert systems, document retrieval systems, and help systems).

However, none of these systems provides holistic support in meeting the



performance needs of the modern knowledge-rich workplace, where information overload is often a major problem. The integrated concept of electronic performance support systems (EPSS) is a possible solution.

Although in its nascent stage, the EPSS approach may well be dubbed the enabling technology for the next millennium.

Systems View

In most modern workplaces computers are used for decisionmaking, performing and sequencing tasks, and planning, thereby replacing many manual methods. The work is done neither by people nor by computers but by human-computer systems. In these situations computers act as a powerful tool by providing an interface to the basic job tasks that are involved. People and computers thus tend to work cooperatively and symbiotically, combining the advantages of the powers of each to achieve more effective job performance (Licklider, 1960). This human-task interaction within the human activity system forms the foundation of electronic performance support systems (EPSS). The computer-based tools (tools subsystem) in the system provide an interface to various job tasks and become an effective aid (and means as well) in achieving efficient task performance.

The human activity system consists of people and other resources, organized to accomplish a purpose or a task (Checkland, 1981). The people in the system are affected by being in the system, and by participating in the system they affect the system. Within the human activity system, an activity is undertaken by humans (actors) motivated toward an object and mediated by tools (tools system) and a community, as suggested in the activity theory (Vygotsky, 1978). This concept is depicted in Figure 1.

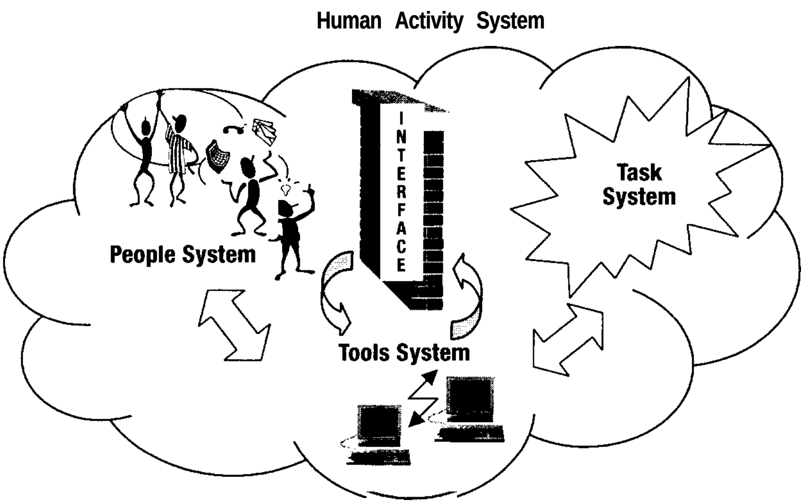


Figure 1. Concept Map of Activity System.

There could be three principal ways in which the tools system interfaces with the task system and three broad classifications of EPSS, depending on how they render support in task performance.

- Type 1: Tasks are performed with computer and software tools, such as word processors and spreadsheets. Support for this type of application can be called software-integrated EPSS.
- Type 2: Computer-based tools mediate the organizational tasks and practices, such as banking systems and enterprise resource planning systems. Support for this type of application can be called job-integrated EPSS.
- Type 3: Computer-based systems mediate and facilitate the various operations and job roles, such as knowledge-based tasks and repair and maintenance jobs. Support for this type of application can be called operation-integrated EPSS.

One of the functions of an EPSS would be to reduce the permeability of the interface.

Performance Equation

To understand EPSS it is necessary to consider the nature of the basic factors that influence the time it takes for a person to perform a task within a given application domain. In general, the total time taken to perform a task (T_{task}) depends on two basic factors: first, the time to find a method (T_{method}) and second, the time for the actual execution of the task ($T_{execute}$). That is: $T_{task} = T_{method} + T_{execute}$

One of the important features of an EPSS is its ability to minimize the overall task performance time. To fulfill this requirement it is necessary to identify which of the factors in the above equation has the largest effect in limiting performance, or what the performance impediments are. Design can then proceed so as to remove any limitations.

Within a human-computer system the time to find a method for performing a task and the time to execute a task will depend on whether the task has to be performed by the human element or the machine component. A breakdown of the factors responsible for task performance time and the possible strategies for reduction of time are shown in Figure 2.

For the sake of simplicity Figure 2 shows separately the contributions of human and machine components in task performance time. In actual application, however, these will complement each other. If the support system is designed suitably it will be an adaptive system that will quickly lead an inexperienced user to competence through an iterative cycle of guiding, teaching, doing, profiling, and feedback. The tool system's competence will also improve through adaptive iterative cycle, leading to overall system compe-

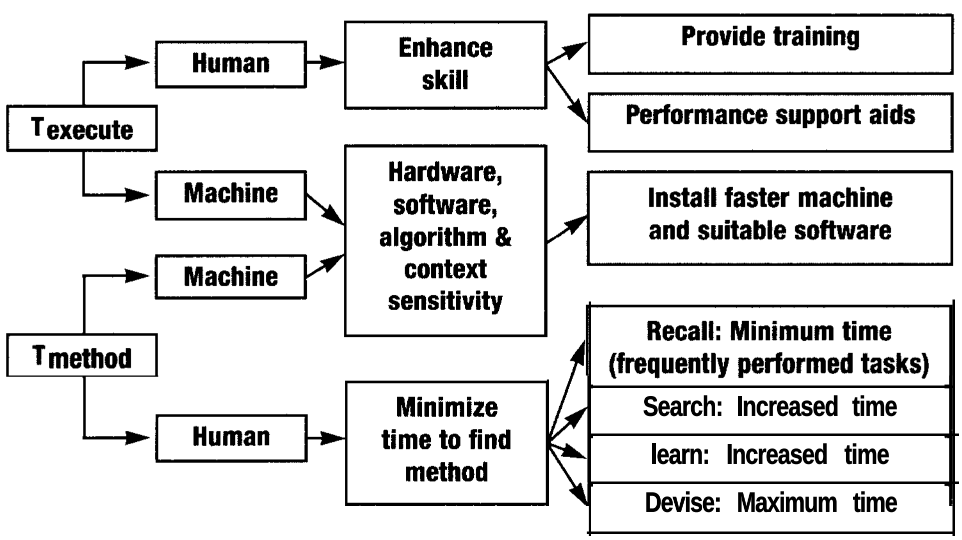


Figure 2. Analysis of Task Performance Time.

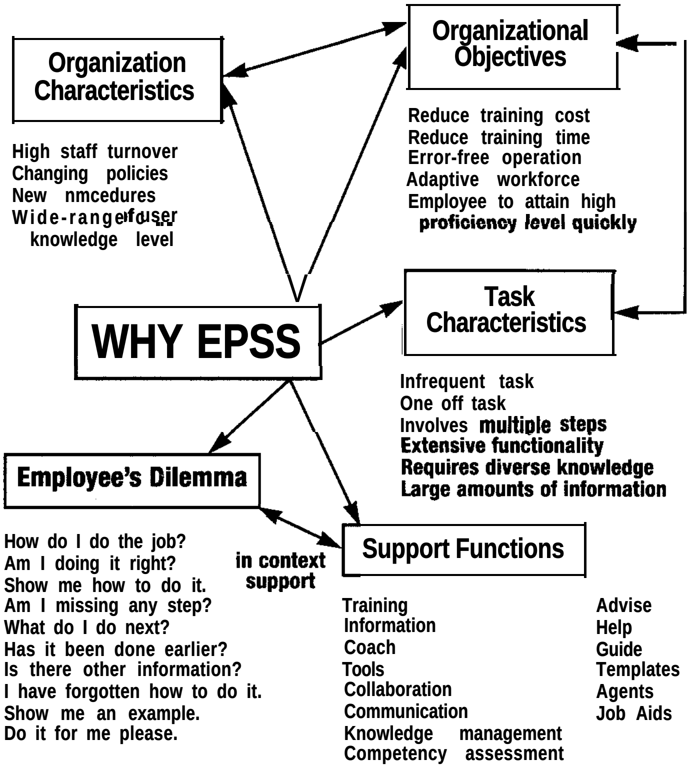


Figure 3. Support Requirements and Circumstances.

tence. Thus the computer's (tool system] job will be to profile, apply, and adapt. In this context knowledge management will be another important aspect for enhancing organizational competence level.

Performance means doing something, especially according to a usual or established method. It also means doing something well. Therefore, besides reducing task performance time, a performance support system will reduce operational error, improve the quality of task performance, and of course, reduce cost. These goals can be achieved through appropriate design of an EPSS (Banerji, 1995; Barker, 1996).

An EPSS will both enable competent performance and reduce the performance gap that arises out of the difference between ideal and actual performance. However, in many situations it may be difficult to quantify this gap. The acid test for the existence of a performance gap is indicated when we encounter the following types of responses from the employees: "Please wait," "I will have to ask my supervisor," "I am sorry, I am new on this job," and "I will get back to you." At the systems and procedure level, a performance gap can be judged from the accident rate, rejections, and complaints. For example, casualty investigation statistics show that nearly 80% of all shipping accidents are caused by human performance error (Banerji, 1997).

Systems Imperative

In addition to meeting the performance gap, the EPSS approach will be required while engineering (and re-engineering) the knowledge-based work environments of future. This arises out of the evolving nature of organizations, their objectives, and the task characteristics, which lead to performance dilemma and performance impediments, as shown in Figure 3.

Design Approaches

While Figure 3 shows a range of support functions for EPSS, implementations can range from simple to complex by combining a few or many of these functions. The design follows a structured query-and-task analysis for identification of the specific functions. Figure 4 shows one method that was used while identifying support needs for lecturers in an academic environment. The analysis led to design of web-based performance support, particularly for new lecturers (e-Mentor). A similar approach was implemented in the redesign of a website that supports students (Banerji, 1999).

Examples

EPSS for Marine Operations

This forms one class of application targeted at reducing the $T_{execute}$ discussed earlier, based on the following analysis.

It is imperative that the members of staff on a ship are fully conversant in safe handling of essential safety equipment. An extensive familiarization program is necessary as members of staff are transferred to different vessels. Currently when a member of staff is posted on board, the supervisor or a visiting superintendent provides training. There is no assessment to gauge the understanding of the personnel. A number of serious accidents have happened during normal shipboard drills, which have been attributed to improper maintenance, lack of skill, and lack of familiarity in the new environment.

To avoid such situations the current regulation requires that a company familiarize its officers with the essential equipment when they join a vessel and keep a record of their training. Ensuring proper competency level of staff therefore has become an urgent requirement. An EPSS is being developed to meet the specific need. The system will allow onboard assessment and remote monitoring from the company headquarters. It will include four items of the EPSS model, namely job aid, training, operating procedure guidance, and assessment of competency (Banerji, 1997).

EPSS for Marine Regulations

This forms another class of application targeted to reducing the T_{method}.

With their numerous amendments and protocols, international regulations provide guidelines for shipbuilding,

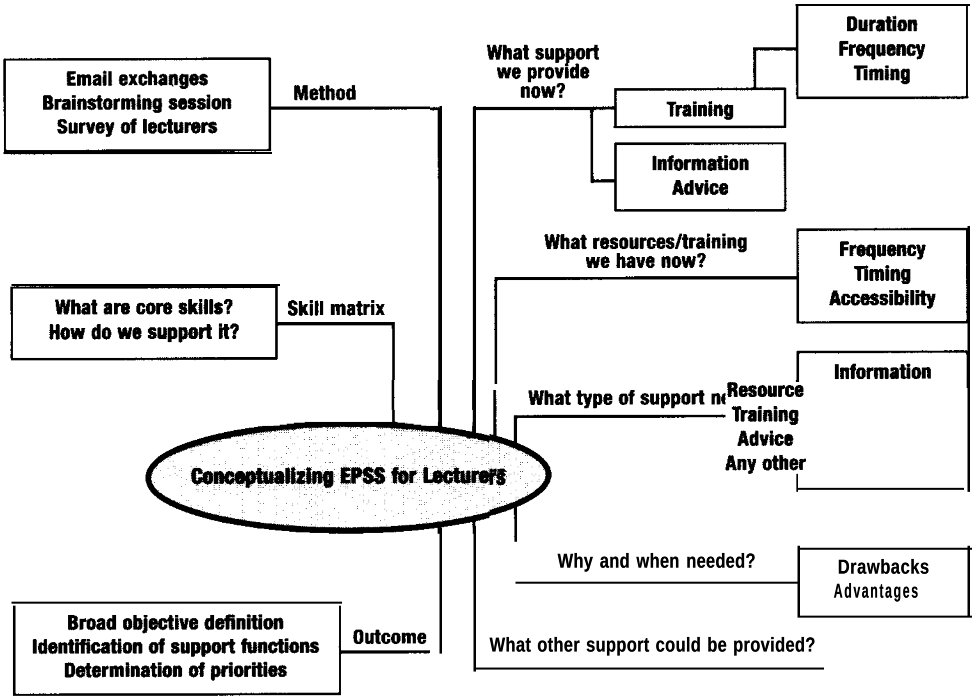


Figure 4. Structured Query-and-Task Analysis Used for e-Mentor Design.

major conversions, and repairs. However, the regulations have become extremely complex and elaborate over the years. Identifying relevant and correct regulation in a particular case has become a daunting task. Even the experts in maritime industries take appreciable time and deliberation to arrive at desired solutions.

An EPSS framework is being adopted to model the complex rules and regulations documents. This will enable the users (ship designers, surveyors, and ship managers) to identify the relevant regulation for a particular case accurately and timely. An EPSS on this aspect will involve four items of the EPSS model, namely reference material, regulations, procedure guidance, and advice.

Conclusion

The EPSS concept originally suggested by Gery (1991) provided an orientation to user-centered and task-centered designs of information systems. It is now considered an attractive approach in many situations. However, complexity arises out of three issues: identification of the specific functions, their implementation, and integration of the functions within the overall environment. The forces that will shape the future of EPSS will be the interaction techniques, cost, portability, authoring tools, embedded systems, information display technology, communication speed, and-most important-context sensitivity of these functions. These will be the subjects of ongoing research and investigations.

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Ashok Banerji is Director, Learning and Performance Consulting at Guru, Inc. He specializes in human computer interaction, advanced educational technology, and electronic performance support. Ashok holds a doctorate in computer science and has conducted research on multimedia, performance support, and simulation-based training for business information systems in high-tech industries He has published and presented more than 25 articles and conference papers on the use of computers in education and task support in international journals and conferences. Ashok can be reached via email at a.banerji@ieee.org.