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General Office
50 Culpeper Street
Warrenton, VA 20186
TEL (540) 347-0055
FAX (540) 349-3169
EMAIL jids_info@lti.org

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Transforming EPSS to Support Organizational Learning

BY DAVID T. BILL

Presently, well into the information age, organizations face an ever increasing tsunami of information. If an organization is to remain competitive and learn from the vast ocean of knowledge created by the technology explosion, it must adopt a systematic network to capture and store information in an accessible format. Only then can the organization begin to learn from the knowledge it has amassed.

Appropriate emerging knowledge should be integrated into the strategic development of the organization (Nonaka 1995). Typically, screening of such information has been a function performed by top management. One soon realizes that screening and archiving the enormous amount of information available is a monumental undertaking for such a limited number of individuals. In addition, the information is filtered through a small percentage of the total sum of the organization's experience base. Realizations such as these attribute to the rediscovery of the learning organization.

The term *learning organization* is defined as an organization that continuously learns and adapts itself. Learning is a continuous and strategically employed system within the organization at all levels. In addition, systems and mechanisms for capturing and sharing knowledge are part of the organizational framework (Watkins and Marsick 1993, 8-9).

organizations face an ever increasing tsunami of information

Using this definition, a case can be made for the embedding of an EPSS within a system of learning. Electronic Performance Support Systems (EPSS) can be used as a nucleus of a systemic network within an organization of knowledge workers for the purpose of fostering organizational learning. This paper will offer a new model for EPSS, functioning as the neural network of a learning organization. Three facets of this new model will be explored as supports of an organizational learning system: knowledge management, system design and individual behavior, and using electronic communication as part of the learning system. The content of this paper is by no a means comprehensive view, but instead offers a framework for further research.

In this paper, the terms *knowledge*, *information*, and *data*, as intellectual capital, have the same connotation. The definition of job task includes the functions such as problem solving, decision making, planning, and data processing.

The Genesis of EPSS

Early definitions of EPSS describe the function as an electronic system to provide access to information, advice, tutorials, and tools to assist the individual in performing a task with the *minimum* support of others. EPSS was an add-on to existing software applications. This model of EPSS converged on creating an environment so that the individual could become an autonomous and self-directed learner (Raybould 1995).

In addition, this model typically implied that EPSS was a single software application with a static database. Early development of these models was nothing more than online job aids such as software wizards, cue cards, or electronic coaches and computer based training (CBT) tutorials (See Olsen and Bozeman 1988 for empirical research on Decision Support Systems).

Recently, with the explosion of faster multitasking hardware and software, new avenues of communication have been created, as well as data storage and retrieval. Various literature touts new technology as a liberating tool that has enabled designers of EPSS to put more information at the finger tips of knowledge workers (Reynolds and Araya 1994, Forman and Kaplan 1994). As a result, EPSS is credited with reducing the amount of time required to access information and bring workers to an entry level of job competency (Bastiaens, Nijhof, and Abma 1996, Tait 1995, Lamy 1994, Bramer and Ghenno 1993, McGraw 1994).

Modern Definitions of EPSS **Table 1**

Author	Definition
Raybould, 1995, p. 11	"...the electronic infrastructure that captures, stores, and distributes individual and corporate knowledge assets throughout an organization to enable an individual to achieve a required level of performance in the fastest possible time and with the minimum of support from other people."
Barker (1995), p.4	"...a human activity system that is able to manipulate large amounts of task related information in order to provide both a problem solving capability and learning opportunities to augment human performance in a job task by providing information and concepts in either a linear or nonlinear way, as and when they are required by the user."
Passmore (1996)	"1. Not as a single piece of software, but as a collection of all software needed for performance support. 2. As the integration of knowledge assets into the interface of software tools, rather than as add-on components. 3. As a method for capturing knowledge assets as well as distributing them. 4. As involved with the management of all knowledge assets, whether electronic or not."

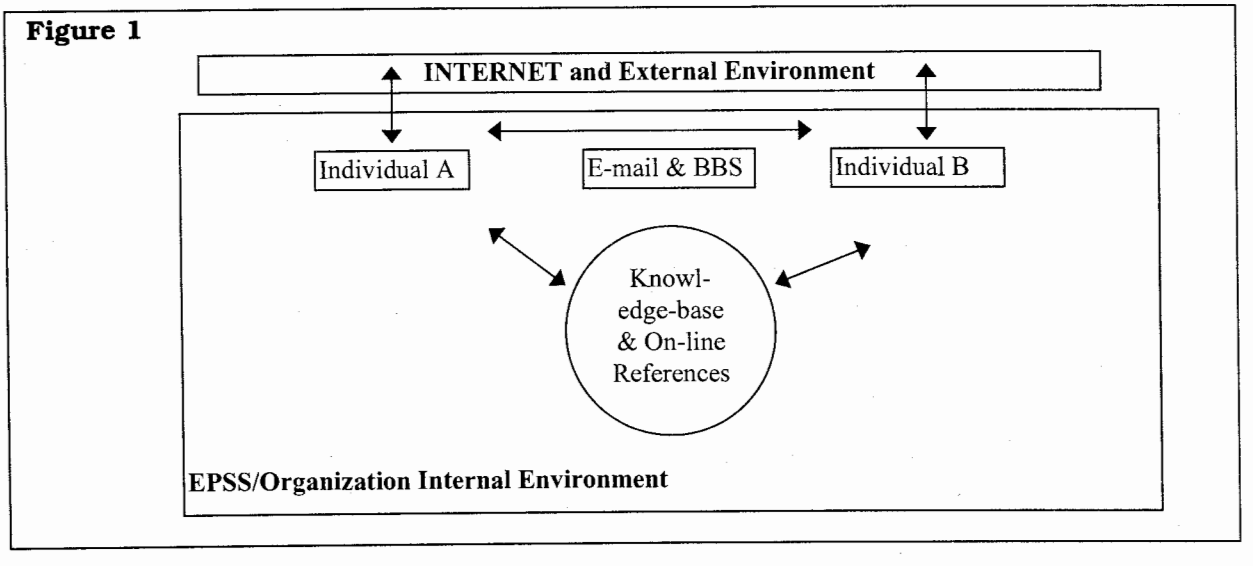
EPSS and the Learning Organization

Since the popularity of Peter Senge's book *The Fifth Discipline*, theorists have begun to look at the potential of EPSS within an organization through a different lens. Hence, the development of more applicable definitions ensued. More recent definitions that will be used for the purpose of comparison are listed in Table 1.

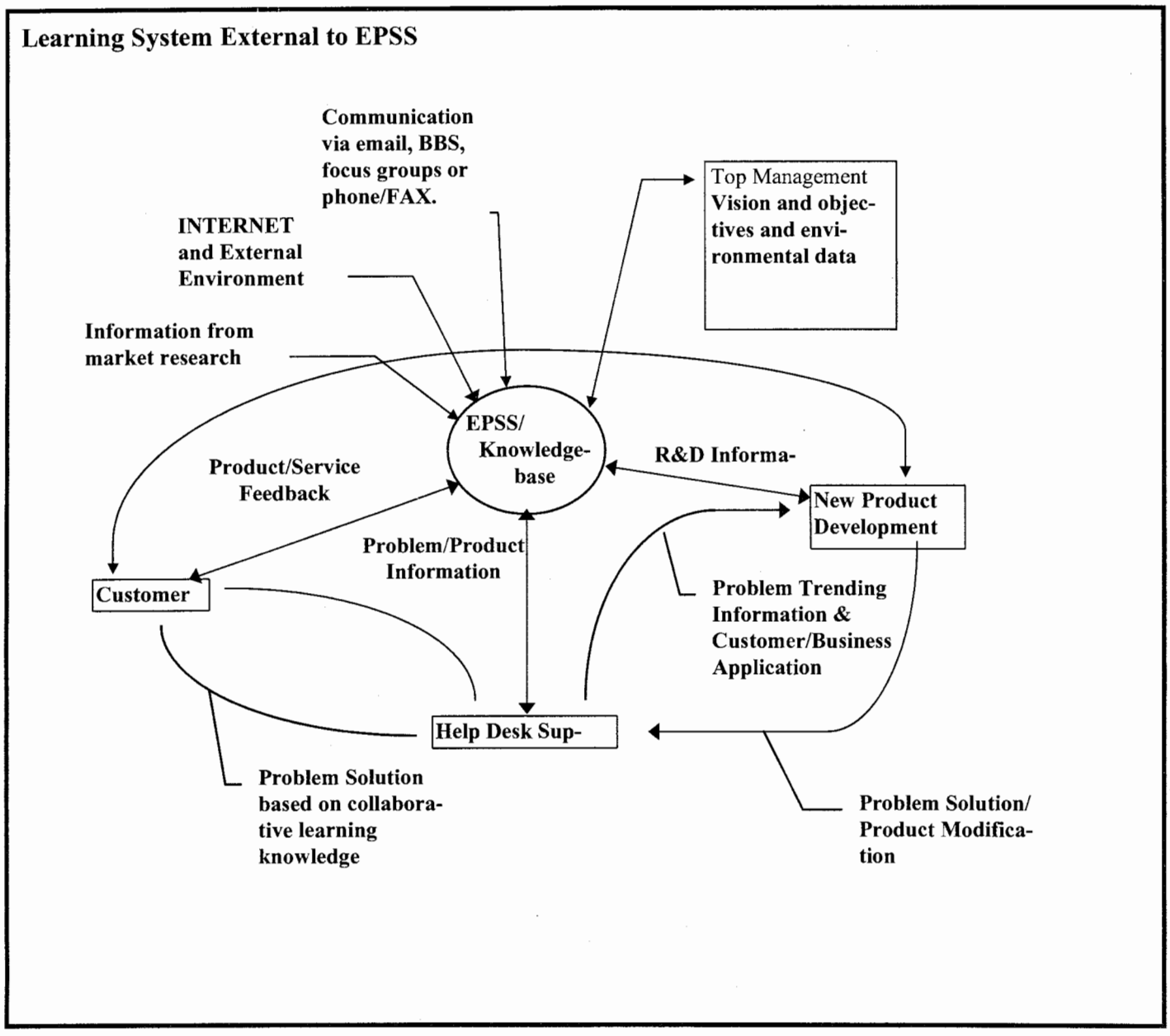
A synthesized definition that evolves the model into a component of a system learning approach would be as follows:

An electronic infrastructure that captures, stores, organizes, and distributes individual and corporate knowledge assets throughout an organization and enhances communication to enable an individual and the organization, to transform existing behavior in order to achieve performance objectives in the fastest possible time.

Figure 1



Learning Organization EPSS Model **FIGURE 2.**



A New EPSS Model

Applying this definition to previous models adjusts the focus of support from the individual to the organization. The proposed model involves a system of communication loops concentric to the knowledgebase[1], a critical component. Previous definitions were focused on the performance of the autonomous individual, participating in little or no collaborative learning. Each input information into the knowledgebase and interpreted the information on an individual basis with little or no communication with entities outside of the individual workstation.

The model in Figure 1. illustrates the flow of information in the new definition of EPSS. Input and feedback loops connect all groups within the learning system with one another and the knowledgebase. Components of the EPSS consist of:

- On-line References
  - Data Tables
  - Help Files
  - Tutorials
- Knowledgebase
- E-mail
- Internet Access

[1] The definition for knowledgebase and a table of types of organizational knowledge will be discussed in the section subtitled **Knowledge Management**.

In this model, information access and communication are unrestricted and encouraged. Individuals draw from the knowledgebase, others' experiences, and the external environment to obtain information to complete required job tasks. In the process, they add to the knowledgebase, thus increasing organizational memory. Knowledge is created by individuals collaboratively or in isolation. An organization cannot create knowledge without the participation of individuals. It is the responsibility of the organization to provide an environment or context that is conducive to knowledge creation (Nonaka 1994).

To apply this model into a practical setting consider Figure 2.

Figure 2 illustrates the flow of information within and into the support and development functions of a manufacturing company. The external learning and knowledge gathering mechanisms input information into the EPSS environment continuously. Therefore the information is current and accessible to all individuals within the organization. Also contained in this model are loops to the external environment, including the customer. Information from the external environment is critical for organizational learning (Argyris 1964, Senge 1990).

Knowledge Management

Given the fact that new technology is increasingly able to store and provide more information to the organization's members, consideration must be given to the organization of the data so as to prevent an information overload. The learning process is less effective if the amount of information exceeds the organization's capacity to adequately process the data (Huber 1991).

One dilemma in this area is the rate of information and the inconsistency of the data (Forman and Kaplan 1994). It must be stored and updated in a repository that provides accessibility and prevents inaccuracy or redundancy within the storage vehicle. It is important to note that intellectual redundancy within the organization will result as individuals access and share information. Redundancy of information allows people to view the same information from different perspectives (Nonaka 1994). The result is the creation of new information.

Furthermore, information created and gathered by an organization is nothing more than unrelated data unless it is organized in an accessible format. In addition, organizations can not learn from the information if it is unretrievable, distorted, fragmented, or inaccurate (Kurke, Weick, and Ravlin, 1989).

There is much literature in the information management field on organizing information with tags and identifiers for fast data retrieval. Much of that methodology has carried over into the development of relational databases for use within an EPSS. The problem lies in the fact that in early models of EPSS, mere data records of facts were stored in the form of online files or CBT tutorials. Often what needs to be captured are scenarios or historical chains of events. The search engine used for retrieving the information must be capable of searching on scenario or case data, as well as key words. An architecture used for this type of data storage is commonly referred to as a *knowledgebase* (Raybould 1995). Knowledgebases store information and allow individuals access to historical knowledge which has been captured by the organization.

One advantage noted of the knowledgebase is that just in time access of required information leads to extension of an individual's long-term memory and reduces the working load memory (Law 1994). The knowledgebase consolidates information into a central location, thus liberating an individual's working memory from such menial data as resource location.

There is a gap in the literature pertaining to the empirical study of which format is most conducive to intuitive knowledge retrieval. As the Artificial Intelligence technology evolves, further research may parallel electronic data storage with human cognitive mapping.

Current technology does offer the incorporation of *expert systems* or decision support systems into EPSS. This technology gives the individual access to knowledge that has been imported into the expert system from third party vendors or information from the organization's knowledgebase (See Berry and Hart 1990 for an in depth discussion on Expert Systems). They also provide a mechanism to solve case-based problems using existing information.

Organizations have many resources to populate the knowledgebase (See Table 2). One area for further empirical study is the filtering process that an organization selects to identify what information is worthy of inclusion in the initial population of the knowledgebase. Then users could be surveyed for gaps in the information required and what is needed to perform job tasks.

Empirical Studies Related to Using Computers to Perform Job Tasks Table 3

Authors	Sample Population	Variables	Hypothesis	Findings	Further Questions for Study
Koohang, A. (1989)	81 undergraduate college students.	gender keyboard familiarity prior computer experience word processor knowledge spreadsheet knowledge database knowledge	Computer familiarity and gender have an affect on the attitude of the individual towards using the computer to perform job tasks.	Males scored higher on computer usefulness attitude scale Subjects with computer experience express more positive attitude than less experienced subjects.	Is there a difference between genders in the competent use of the EPSS based on cultural values? Is computer experience a reliable predictor to an individual's EPSS competence?
Authur, W. Jr. and D. Hart (1990)	62 full and part-time college students	gender computer familiarity cognitive ability	Cognitive ability may contribute to the level computer familiarity.	Strong positive correlation between an individual's cognitive ability and the level of computer familiarity.	What is the relationship between the intuitive design of the user interface and willingness of individuals with low cognitive ability to use the system? Can the integration of expert systems reduce the ability gap between high and low cognitive abilities?
Sacks, C., Y. Bellisimo, and J. Mergendoller (1993)	32 high school students (17 male 15 female)	gender computer familiarity time computer attitude	Attitudes towards computers would correlate positively as computer familiarity increases over time.	There was no significant difference between genders in computer use Experience leads to more positive attitudes towards computers.	Will organizational learning increase as familiarity with the medium increases?
Baack, S., T. Brown, and J. Brown (1991)	235 younger adults M=22.4 years. 184 older adults M=73.6 years.	Age Computer attitude Computer familiarity	Older adults have a less positive attitude towards computers than younger adults, which reflects their lower level of familiarity with computers.	There is a positive correlation between attitudes towards computers & levels of familiarity in older adults.	What are the conditions required to have older adults participate in an electronic medium?
Mitchell, R., M. Crawford, and R. Madden (1985)	100 teaching professionals 100 non-teaching professionals	Attitude toward electronic communication systems Competencies required for electronic communication within the organization Change in organizational structure.	Business/ organizational communication curricula should emphasize electronic communication systems as a tool to communicate with others inside and outside of the organization as a means to access timely and accurate information.	Key competencies are required by individuals to adapt to an electronic communication medium. Organizational structure changes must occur in order for the communication to be effective.	Does the use of the electronic communication exclude incompetent individuals from participating in organizational learning?

Congenital Knowledge

Congenital knowledge is the sum of the knowledge which was inborn at the founding of the organization and that which was amassed previous to that point in time (Huber 1991). Often the organization's founders scan the market environment and collect information about the niche in which they are hoping to thrive. In addition, individuals that join the organization bring a knowledgebase with them. Such knowledge, once captured, becomes cumulative as the organization experiences turnover of individuals.

Other important information such as mission of the organization and vision of the principles should be accessible by employees. Departments can add their mission objectives so that employees can conceptualize how each of the parts supports the organizational system.

Scanned from External Environment

If an organization is to remain viable in the market place, it is eternally dependent on that environment to consume its products and/or services. It is from that environment that the organization must gather information to make decisions, thus transforming and learning in the process (Argyris 1964).

The organization must have a propensity for scanning its external environment to acquire information to update the knowledgebase. As depicted in Figure 2., the knowledgebase provides an effective vehicle to store and provide access for individuals to information pertaining to the external environment. An example would be if new product software developers could access current sales of Windows™ based computer to video production service bureaus and the results from the last customer survey on system functionality preferences, they could use that knowledge to make R&D decisions ahead of the market.

Knowledge can also be acquired from competitors' products and research as well as published reports. A popular method for scanning the environment is the use of the Internet. Through this medium, an organization can have access to a wealth of information from online services, web sites, and news groups.

Experiential

Another source of acquiring knowledge is through the experiences of the organization and its individuals. This source of knowledge also includes research and development efforts by the organization. It is noted that experiments are a worthless source of information if the individuals participating can't recall the facts of the event accurately (Kurke, Weick, and Ravlin, 1989), therefore it is imperative that R&D data be captured as close to the event as possible.

Adding the collective experience of individuals is a very rich source of knowledge for the organization. Referring once again to Figure 2., the learning forums between the groups could be in the form of electronic bulletin boards. This is particularly useful when the groups are separated by a distance or time. The forums can also be conducted in an off-line medium.

If the EPSS incorporates Internet access to its users, then the organization can benefit from the experiences of those outside of the organization through various electronic means (i.e. listserves, BBS, FTPs, web sites, etc.).

System Design Considerations and Individual Behavior

Since the method of communication in the proposed model is rooted in an electronic medium, it is necessary to explore the possible barriers to learning that may be present. Since the organization will not be the entity that is interfacing with the medium, we must focus on the individual.

Although there are many case studies by various EPSS vendors on the cost effectiveness of the technology over traditional classroom training, empirical research on the effectiveness of an EPSS as a learning environment is scarce. The one notable empirical study is that on small sample of telephone operators (See Bastiaens, Nijhof, and Abama 1996).

Although empirical studies in the area of human-computer interfaces exist, there is little research in the human-EPSS interface. A crucial facet of the EPSS is ensuring that the means through which the user is communicating with the system is intuitive, consistent, and free from errors (McGraw 1992). Because the individuals using the EPSS will be very diverse, it is critical to explore the variables of this interface.

A study of telephone operators using an EPSS to perform job tasks revealed low computer usage rates among members of the sample group. Reasons cited for the low use included outdated information in the knowledgebase and a cumbersome user interface (Bastiaens, Nijhof, and Abma 1996).

Further examination of research on computer usage and attitude supports the observations made in the Bastiaens, Nijhof and Abma study. Findings describe a relationship between the perception of usefulness of computers to perform job tasks and the level of usage (Koohang, 1989; Sacks, Bellisimo, and Mergendoller, 1993; Baack, Brown, and Brown, 1991).

Skill Competencies Required in an Electronic Communication Environment (Table 4). Mitchell, Crawford, and Madden (1985)
• Able to use a keyboard.
• Mastery of reading, writing, and organizational skills.
• Able to synthesize data and reports.
• Able to access databases during document preparation.
• Able to use one-way and two-way, not face to face, communication.
• Able to deal with stress among individuals using electronic communication technology.
• Able to overcome the psychological need for face to face contact with persons when communicating.

Organizational Structure/Procedure Changes Required for Successful Electronic Communication (Table 5) Mitchell, Crawford, and Madden (1985)
• De-emphasis on the geographic location of individuals.
• Lack of traditional authority/power lines as information becomes more accessible to individuals.
• Flattening of the organizational hierarchy.
• Promotion of teamwork among executives as physical isolation is diminished.
• Increased speed of decision making as information delays are diminished.
• Increased quantity and timeliness of information accessible from within or external to the organization.
• Sharing information electronically.

In addition, all studies identified a positive correlation between favorable attitudes toward computers and computer familiarity. A question for further research is *as individuals become increasingly familiar with the technology and the subject matter, does the individual become more willing to explore sources of knowledge to obtain information to perform job tasks?*

Other considerations for the individual are those of gender, age, and cognitive ability. Attitudes toward computers differ between the genders. Males tend to display more positives attitudes toward computers, regardless of the level of familiarity, while female attitudes become more positive as the level of familiarity increases (Sacks, Bellisimo, and Mergendoller, 1993). In contrast, a survey of older adults indicated that they are less likely than their younger counterparts to use a computer unless there is a perceived need. The same study attributed the low usage rates to low levels of familiarity (Baack, Brown, and Brown 1991).

A third study identified a positive relationship between cognitive ability and computer familiarity. The study suggests that individuals with low cognitive ability levels may consciously opt not to become familiar with computers due to the challenging nature of the technology (Arthur and Hart 1990). Embedding Decision Support Systems, coaches, or wizards may provide assistance to this population of potential users, although there is little evidence to support their effectiveness as a learning tool (Olsen and Bozeman 1988). Further empirical studies would be needed to explore the effectiveness of such vehicles in an EPSS for said individuals.

The danger that can be inferred from these studies is that an exclusive environment can be unintentionally created. The same medium that can offer such a rich learning environment for some can be another's barrier to learning.

E-mail as a Communication Medium

Another important facet of the proposed EPSS framework is the use of electronic communication systems to share and search for information. E-mail can be used to transmit inquiries and share knowledge rapidly over distance and time. Electronic Bulletin Board Systems (BBS) and listservers can provide a mechanism to capture e-mail conversations. Individuals can post questions to draw on the collective knowledge of an organization to solve a problem. If used externally, the organization can benefit from the collective knowledge of individuals outside of its internal population.

Mitchell, Crawford, and Madden (1985) identified key competencies required by individuals and suggest structures within an organization for an electronic medium to function effectively (Tables 4 & 5).

A crucial support structure identified by the individuals in the study is the accessibility of information. Information has the propensity to be altered and degraded as it is interpreted by individuals (Kurke, Weick, and Ravlin 1989). If an organization is flattened by giving all individuals equal access to the same information, the opportunity for inference and distortion is reduced.

Items in Table 5 are applicable to the entire EPSS environment. The true potential of the new EPSS framework proposed can only be realized when these issues have been addressed within the organization. Much research is needed to study the learning potential of the organization, once a knowledge network has been established and all individuals posses equal accessibility to information.

Conclusions

A new framework for EPSS has been suggested as a tool to support the learning organization. It is not enough to invest in the technology alone, *learning support systems must be in place, working in conjunction with the EPSS to cultivate learning environments within the organization.*

Through the use of electronic communication, individuals can validate, expand, and update organizational memory by scanning the external environment and capturing knowledge that exists within the organization. The organization and its individuals must view every person, experience, object, and other organization as a potential source of knowledge.

Knowledge must be captured in an organized format so that later it can be modified and accessed by individuals for the purposes of performing job tasks. Through the use of knowledgebases, organizational memory can be preserved and expanded, thus providing individuals a rich information resource.

The human-EPSS interface must be user friendly and intuitive in order to gain acceptance by individuals and the organization as a job tool. In addition, individuals must be given time to become familiar with the new medium and be given the skills necessary to communicate with sources of information. The most critical element is that information must be unrestricted and freely accessible by all individuals within the organization to maintain an open learning system.

Suggested Readings

Journals

Journal of Research on Computing in Education
Journal of Artificial Intelligence in Education
Journal of Business Communication
Communication Research

Books

Berry, Diane, and Anna Hart. 1990 Expert Systems: Human Issues. Cambridge, MA: The MIT Press.

Boose and Gaines. Knowledge Acquisition for Knowledge-Based Systems, Vols. 1 & 2. New York, NY: Brace Jovanovich.

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Web Sites

EPSS.COM. http:/www.epss.com
Pennsylvania State University EPSS web site.
http://milkman.cac.psu.edu/~cx118/epss/epss.html
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About the Author

David T. Bill, Senior Instructional Designer
Centurion Systems, Inc.
5 Concourse Parkway, Suite 2160
Atlanta, GA 30328
Voice (770) 392-0090 ext. 232
Email DavidB@centurionsys.com

Dave is the Senior Instructional Designer at Centurion Systems where he oversees the organization's instructional design efforts and provides design consulting. He has 15 years of experience with electronic media and workforce/adult education. His accomplishments include designing systems with a focus on OD, Distance Learning and performance support. Dave's experience as an electronic engineer, coupled with his studies at Southern Illinois University and the University of Georgia, provides the foundation for his design research at Centurion. Currently, he is pursuing a doctorate degree in Organizational Development at The University of Georgia.