

Evolving Interactive Electronic Technical Manuals (IETMs) to Electronic Performance Support Systems (EPSS): Human Performance Considerations

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ABSTRACT

The Department of Defense community realizes that the availability of meaningful and accurate technical information is necessary to support the maintenance of defense systems. Recently, paper documentation has begun to be replaced with Interactive Electronic Technical Manuals (IETMs). IETMs are designed to enable a technician to walk through complex maintenance procedures in a logical sequence and provide detailed support for fault isolation and repair.

Because of their focus on performance aiding, IETMs are sometimes classified as an electronic performance support system (EPSS). However, the focus, design goals, construct, and performance outcomes differ significantly between an IETM and an EPSS. While higher-order (i.e., level 5) IETMs provide context filtering, where the display is driven by conditions that are controlled by variables and expressions, it still is focused primarily on documenting an equipment system. In contrast, an EPSS moves beyond the reference-based paradigm to provide a comprehensive electronic support environment that provides access to integrated performance-aiding tools, task structuring, decision aiding, and contextual access to structured knowledge within a job task framework.

Today's emphasis on the development of standards to promote efficient IETM development overlooks several critical aspects of human usability and job task performance. Studies cite numerous insufficiencies with currently available IETMs (level 4 and 5), which can be effectively addressed by evolving IETM design to an EPSS paradigm.

The International Programs Directorate within the U.S. Navy's Center for Surface Combat Systems, located in Dahlgren, Virginia, sponsored the development of a next-generation EPSS for the Aegis weapons system navigation and interface system as employed by the Japanese Maritime Self-Defense Force (JMSDF). The EPSS institutionalizes subject matter expert knowledge, leverages the availability of a synthetic skills trainer through the use of performance-augmented simulation, supports multiple contexts of use, employs dynamic hypertext capabilities to enhance textual content, and employs visualization techniques to support visual and spatial performance styles. This paper will discuss this evolutionary approach and discuss the benefits to be derived.

ABOUT THE AUTHORS

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INTRODUCTION

The Department of Defense community realizes that accurate technical information is necessary to support today's sophisticated military systems. Technical publications have historically documented much of this information and have been created to reduce the need to commit technical data to memory. Since eighty to ninety percent of a person's job knowledge is gained on the job and only ten to twenty percent is gained through formal learning events (Williams, 2003), timely access to accurate technical data—task procedures, complex schematics, and troubleshooting protocol—helps to facilitate on-the-job performance and reduce the time to attain job proficiency. But traditional print-based technical manuals are cumbersome to use and difficult to keep current. And the sheer volume of paper can be overwhelming. So when a system malfunctions, a piece of equipment breaks down or a network goes off-line, the technician responsible for maintenance must pore through these volumes that often include confusing cross-references and outdated information.

Increasingly, technicians are being provided with an option other than bulky technical manuals to retrieve information electronically. The military services have been investing more and more in moving publications to electronic delivery systems known as Interactive Electronic Technical Manuals (IETMs). IETMs are intended to support a technician through complex maintenance procedures and to provide detailed support for fault isolation and repair.

The maintenance of defense systems has been impacted by three significant trends within DoD organizations: (1) paper documentation is being replaced by electronic manuals at a rapid pace, (2) the number of personnel performing the work is shrinking, and (3) the amount of specialized training that maintainers receive to keep systems at full operational readiness is being reduced (Siegel, 2001).

In addition, continuous technical improvements in equipment components means that parts last longer and

mean-time-between-failure rates have increased considerably. This trend puts maintainers into a performer category that Nielsen (1993) defines as a *casual user*: people who are using a system at irregular intervals rather than having the fairly frequent use assumed for expert users. Unlike a novice user, who may read a manual from beginning to end, the casual user has some task knowledge and will approach the support system with a specific performance goal in mind, i.e., perform an explicit task, make a decision, or solve a problem. The casual user generally follows a targeted navigation path and performs ad hoc searches to find information only about the things he has forgotten (Brinkman, 2001).

Unfortunately, many of today's methods for delivering technical information and aiding workplace performance do not consider these trends and are not designed with an understanding of the human performer. As a result, they are not usable in the field, and *interactivity* is often nothing more than electronic page turning. But never before has it been so important to design performance-aiding systems with the human performer in mind. Consider these scenarios:

- Corporal Washington must perform an immediate equipment swap-out of a faulty GPS on his Bradley Fighting Vehicle during escort operations on the road to Baghdad.
- IC1 McCormick loses the heading reading on the Aegis weapons system navigation control panel during exercises and needs to quickly determine the source of the problem.
- Airman Detweiller is recently assigned and must perform electrical fault isolation on a complex Link 16 system.

While each of these scenarios describes a very different situation, they share these four common characteristics:

1. A human is central to the performance of each activity,
2. An equipment platform or defense system is the target focus of the activity,
3. Specific knowledge and information is required to successfully perform the activity, and

4. Inferior performance (error, missed step, time delay) can result in mission failure, equipment damage, or even loss of life.

These scenarios underscore the need for targeted and on-demand decision aiding and task mentoring that goes above and beyond current support methods and does not rely entirely on preparatory training and “in-the-head” knowledge.

ARE IETMS THE SOLUTION?

The concept of an Interactive Electronic Technical Manual (IETM) was first introduced during the 1980s. An IETM was intended to be the functional equivalent of a paper-based technical manual and in most cases a total replacement for the paper manual. The primary driver behind early IETM initiatives was concern for the growing amount of technical information required to operate and maintain advanced weapon systems.

Across the Services, the volume of technical documentation is staggering. In recent years, Navy ships leaving port have carried tens of thousands of pages of technical manuals, often stored in row after row of binders. The technical manuals needed to maintain a single Marine helicopter include some 14,000 pages of text and drawings and can weigh 150 pounds. And in the Army, technical publications comprise approximately 80% of the Service’s publication environment.

The interest in electronic delivery increased through the 80s and 90s, along with the wide-spread and growing use of electronic publications developed in a variety of non-compatible formats. This prompted the DoD to develop standards and definitions for IETM function and development. In 1993, the DoD proposed a set of standards for IETMs that later evolved into five classes. A brief overview of these five IETM classes is presented in **Figure 1**.

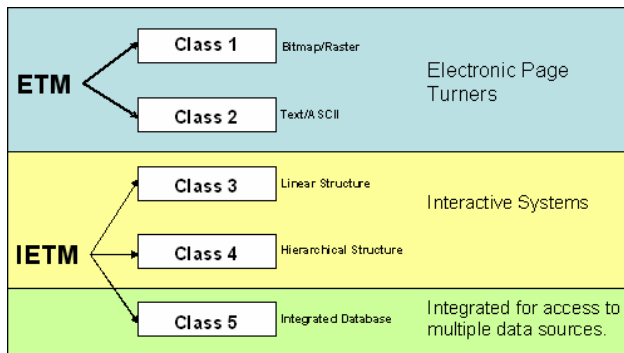


Figure 1. Five IETM Classes

IETM development generally falls into two categories: *conversion* of legacy technical manuals and *new authoring and development*. The majority of IETM development efforts are simply electronically imaged replicas of the paper technical manuals (e.g., Adobe Acrobat pages), which provides for no interaction other than an index for hypertext navigation to another page in the document. These are correctly referred to as ETMs (Electronic Technical Manuals). To truly be considered an *Interactive* Electronic Technical Manual, the system must have authored-in features for interacting with the user, such as prompting, requests for technician input, conditional branching, etc. Within this category, efforts often focus on the redesign of static reference material into an interactive tool.

DESIGNING FOR HUMAN PERFORMANCE OR ECONOMICS?

When the military services decide to no longer carry paper manuals aboard ship or into the field, technicians must be able to rely on the IETM for all technical information. It must be capable of walking a novice through a complex maintenance procedure during a mission-critical event. If the system proves unusable, the technician will not have the paper-based manual to fall back on.

Foltz (2001) states that economic considerations most strongly motivate the implementation and use of IETMs, which are not directly tied to their usefulness and usability. Chief among these considerations have been the cost-saving and speed advantages of paper-to-electronic conversion, and enabling automatic dissemination and update. Each of the military services has established programs to assess the cost-effectiveness of the IETM concept in satisfying maintenance and logistic support needs. These programs focus on reduced costs realized with IETM use: reduced paper storage, reproduction and distribution costs; and faster content update.

Due largely to the economic gains from paper-to-electronic conversion, IETM development and use is continuing to expand. Commercial off-the-shelf (COTS) authoring tools have become more feature-rich, cheaper, and more widely available. These COTS tools provide template-based look-and-feel, standard functionality and automated text conversion. Most employ similar interface and navigation designs based on hypertext-manual systems such as SuperBook.

Content management and interoperability issues for technical data have gained increasing interest over the past few years. Fueled by the federal Advanced Distributed Learning (ADL) efforts to manage and

reuse learning content, efforts have now expanded to focus on standardization of technical support data (specifically IETMs). The creation of metadata tagged information objects early in the design manufacturing process for an equipment component is desired to ensure that the information is correct from a design and engineering standpoint. These information objects then hold the promise of being able to be used within multiple learning and maintenance-aiding solutions, such as paper manuals, IETMs, electronic courseware, job performance aids, and electronic performance support systems.

A cooperative international effort has been initiated to develop international specifications for the format and structure of electronic technical manuals. Starting with the AECMA Specification 1000D (S1000D), a current working group is looking to identify the relationship between various data standards, e.g., how the steps of an ADL Sharable Content Object (SCO) are related to the content of a S1000D Data Module. S1000D is an international specification for technical publications. Content objects are produced in modular, self-contained units called *data modules*, which reside in a common database.

Some US military programs have already adopted S1000D as their IETM specification. While standardization of IETMs may provide considerable cost savings in document conversion and new content creation, it in no way guarantees that the resulting IETM will be an effective work tool. In fact, today's emphasis on the development of standards to promote efficient and cost-effective IETM development overlooks critical aspects of human usability and job task performance. While technical data content objects may be designed to meet all the ADL goals of reusability, durability, interoperability, and maintainability, they fail if they cannot be assembled and applied in a way that facilitates and improves human performance.

IETM PERFORMANCE DEFICIENCIES

When applied to performance-aiding solutions like an IETM or job performance aid, the term "usability" has been defined by Chaparro & Groff (2002) to address the total "user experience," i.e., how easy these systems are to use and navigate, how well they match the technician's representation of the task, how easy they are to read and interpret, and how meaningful and useful the information is that they contain.

Significant expectations have been set about the effectiveness and role that IETMs will have in aiding performance and helping lesser skilled maintainers

perform their jobs. Various studies have been conducted over the past ten years that present empirical and anecdotal evidence of usability, technician acceptance, and preference for using IETMs as compared to paper manuals (French, 2004). Most of these studies have been limited to Class 2, 3, and 4 IETMs, which are fundamentally "document readers."

Studies have cited performance improvements such as reduced false removal rates and increased effectiveness in fault isolation using IETMs as compared with paper manuals (CALs Desktop Guide, 1999). But when data collection activities for these studies included going out to the work centers, repair depots, and ships, the findings often indicate that maintainers do not feel that the IETMs available today provide the most efficient method for job-site performance support. Deck plate feedback from the sailors indicates that they don't like IETMs. They find them cumbersome and usually print the pages they need. During a recent study (Siegel, 2001), a maintainer commented on current IETMs:

I prefer to use paper pubs, and when they don't have them then I navigate the IETMs. IETMs are pretty hard to navigate around. I don't know too many people that are extremely happy the way IETMs navigates. It's a great concept; it just needs some work.

A web site that serves as a community of practice of sorts for military maintainers includes a list of "You know you're a maintainer if..." quotations. This humorous, yet serious, look at what it takes to be a maintainer includes statement #49: "You know you're a maintainer if you are faster than the IETMs" (<http://www.safetycenter.navy.mil/media/mech/YouKnowYoureMaintainer.htm>).

Five major insufficiencies with currently available Level 2-4 IETMs have been cited:

1. **Lack of task context**—The information display area of the IETM interface is generally divided into two sections, one for the textual steps of the procedure, and one for the accompanying illustrations. In the left section, IETMs often show only one procedural step at a time, giving the maintainer no context within the procedure as a whole (Siegel, 2001). Participants in this study indicated a strong preference for the ability to have a sense of the whole task versus having an online application that closely mimicked the paper documentation. Another study concluded that an online support system can provide better support than a paper manual only when it can give contextual advice at the moment that problems are

likely to arise, thus avoiding the need to search for information to solve problems (Brinkman, 2001).

2. ***Inability to support the maintainer's mental model***—Technicians do not want to scroll through pages of data to find the information they need. Like all reference data, technicians approach IETMs with a task-oriented mental model (Andrisani, 2000). Unfortunately, most IETMs are organized around an equipment-oriented model, which requires that the maintainer make a cognitive bridge from their normal task orientation. The Siegel study (2001) also identifies considerable problems with the location of screen controls and buttons within most COTS IETM tools, which “seem to have been scattered across the screen at random, rather than having an organization related to the users’ mental or task models.”
3. ***Insufficient adaptation for performer diversity***—IETMs generally do not provide adaptability to a user’s experience level. But to be effective, a performance-aiding system must accommodate both novices and experts. Experts are looking for help performing more complex or infrequent tasks, while novices need help with basic tasks. Experts want in-depth explanations of how the hardware works, while novices only want to complete a task as quickly as possible (Hackos, 1997). The one-size-fits-all design imposed by today’s IETM authoring tools cannot address this diversity in performer needs, since the content is designed to the constraints of the template, not to an understanding of how it will be used (or by whom). Less experienced maintainers appear to need additional support to conduct tasks that may render IETMs to be insufficient due to a lack of additional support resources and guidance.
4. ***Inability to view and track large schematic images***—Being able to keep track of location and orientation of a wiring diagram or other large schematic image with any resource other than paper is a tremendous challenge and hinders performance of troubleshooting and maintenance tasks (Siegel, 2001). In a paper environment, technicians will lay out schematic drawings and use a pen or finger to trace an electrical or signal path during fault isolation tasks. This type of interaction does not translate well from paper to online environments. Further, the format and display options available through IETM authoring tools and templates is greatly constrained and generally provides only zoom capabilities for increasing the screen display size. Providing a high

level of interaction and dynamic schematic support to novice personnel or generalized maintainers who need to interact with online support systems is not feasible using today’s IETMs (Siegel, 2001).

5. ***Reliance on too much text***—Operators do not want to pour through excessive IETM text, but prefer images, pictures, color and other visual media to help learn and perform. Studies have pointed to the need to minimize text and incorporate an increased use of concept maps that use color and images in place of text, system diagrams to help visualize the links between parts of a system, and interactive schematics and images to demonstrate perspective and spatial relationships (Foltz, 2001).

COMPARING IETMS & EPSS

Because of their focus on performance aiding, IETMs are sometimes classified as an *electronic performance support system* (EPSS). However, the focus, design goals, construct, and performance outcomes differ significantly between an IETM and an EPSS. An IETM is essentially a hypertext technical manual, which means its primary purpose is to provide reference-based support for the diagnostics, maintenance, and repair of complex technical systems. While higher-order (i.e., level 5) IETMs provide context filtering, where the display is driven by conditions that are controlled by variables and expressions, it still is focused primarily on documenting an equipment system.

In contrast, an EPSS moves beyond the reference-based paradigm to provide a comprehensive electronic support environment that provides access to integrated performance-aiding tools, task structuring, decision aiding, and contextual access to structured knowledge within a job task framework. An EPSS is structured to provide immediate, individualized on-line access to the full range of information, software, guidance, advice and assistance, data, images, tools, and assessment and monitoring systems to permit job performance with minimal support and intervention by others. An EPSS improves employee performance by reducing the complexity or number of steps required to perform a task, providing the performance information a user needs to perform a task, or providing a decision support system that enables a user to identify the action that is appropriate for a particular set of conditions.

The following table, adapted from work conducted at the Naval Undersea Warfare Center, Division Keyport, (2004) lists the differences in key attributes between an EPSS and IETM.

Table 1. EPSS & IETM Comparison

| Attribute | EPSS | IETM (level II – IV) |
|---|--|--|
| <i>How Solution is Identified</i> | Recommended as a result of a human performance analysis | Explicit requirement in weapons system acquisition |
| <i>Objective</i> | Ensure accurate & timely task accomplishment | Fully document equipment system |
| <i>Target</i> | Human performer | Equipment or system |
| <i>Information included</i> | Information necessary to support task performance at the moment of need | Information relevant to system and components |
| <i>Content Analysis Methodology</i> | Cognitive task analysis; work observation; contextual inquiry | Capture of system information for completeness & accuracy |
| <i>Visual Interface</i> | Highly customized to specific job performance requirements and worker diversity | “One-size-fits-all” standard template design via authoring tool |
| <i>Support for Standardized Content</i> | Able to draw upon standardized objects (SCORM, S1000D, RLO/RIO) from content repository | Support for SGML and growing support for emerging S1000D, XML standards |
| <i>Taxonomy</i> | Task- and workflow-based | Reference- and equipment-based |
| <i>Ability to Maintain Task Context</i> | Provides visual depiction of task flow and/or hierarchy with contextual links to support artifacts | Often depicts only a single step of a process; links only to information relative to equipment |

DESIGNING FOR PERFORMANCE

Electronic performance support system design considers both the science of learning and the concepts of human performance. Specifically, the human performance domain includes the principles of *human systems integration* (HSI) and *human performance design*. HSI is a human-centered, systems engineering process which focuses on the human as part of the system design process (Nagle, 2002). Human performance design is essentially *context design*. By applying these to the design of performance-aiding systems such as EPSS, the probability of successful work performance increases significantly.

An EPSS is created to help people work better, so one cannot be designed well without a deep understanding of how people work. Analysis techniques such as *contextual inquiry* gather the necessary data, but producing a good performance support system requires a systematic design process that results in an interface that:

- Structures the work process
- Aids in goal establishment
- Establishes and maintains a work context

- Reflects natural work situations
- Provides contextual feedback
- Accommodates performer diversity
- Provides cues to next steps, options and available resources (Gery, 1995)

While learning is not an explicit outcome of an EPSS, these systems support one of the four major methods of learning identified in the Navy’s Executive Review of Naval Training: *On-the-Job Learning and Mentoring*. These task mentoring and decision aiding systems supplement the interactions that a performer has with equipment, workmates, and/or situations and provide a mechanism for continuous learning (ERNT, 2001).

The design of these support systems explicitly draws upon cognitive science as a basis for understanding how people think about and approach work. User experience and situation are integrated into the design process; otherwise, performers are forced to accommodate for a less-than-optimal design. Situational awareness is used to reduce the amount of explicit input a technician is required to give a computer. Contextual information—what the task is, what the user knows, and what the system capabilities

are— is gained during human performance analysis and then used to impart system design that greatly enhances the user experience. Use of contextual models and dynamically driven information displays also reduce the teaching needed for the performer to accomplish complex tasks.

BALANCING ECONCOMICS & HUMAN PERFORMANCE USING EPSS

Let's face it. Like early custom courseware development, EPSS, when approached as a custom design and development effort, can be expensive. But this holds true for Level 4-5 IETMs or any highly customized effort. Simulations, expert systems, and even high-end web-based courseware can cost hundreds of thousands of dollars to develop. Today, however, courseware development is evolving to a more cost-efficient model that combines highly *customized context design* (i.e., instructional design) with *standardized content design* (i.e., SCORM).

This model provides cost efficiencies without compromising learning outcomes. Just as instructional designers realize that we can never adopt a one-size-fits-all approach to learning design and selection of instructional strategies, we should never adopt this cookie-cutter approach for solutions that support job performance at the point of need. At its most basic level, this model allows computers to do what they do well and humans to do what they do well. Computers can store, automate, organize, track, locate, and categorize large repositories of content. But designing for human performance still requires human creativity and knowledge.

When an object-oriented design and development model is employed for EPSS systems, drawing upon standardized "task objects" and other support artifacts contained in a data repository, cost savings can be realized through the reusability and durability across related systems. Additional efficiencies are gained through an accurate and systematic human performance analysis: choosing the right combination of performance-aiding tools and media that will make the greatest operational impact for the lowest investment.

So, today's EPSS development can take full advantage of emerging content standards and design methods, as well as good human performance design. This can help drive down development costs without the negative and costly impact on mission performance that can result from reference-only based solutions.

AEGIS EPSS PROJECT OVERVIEW

The International Programs Directorate within the U.S. Navy's Center for Surface Combat Systems, located in Dahlgren, Virginia, has sponsored the development of a next-generation EPSS for the Aegis weapons system navigation and interface system as employed by the Japanese Maritime Self-Defense Force (JMSDF). This Aegis EPSS is targeted to maintenance personnel onboard surface combatants employing the Aegis weapons system. The EPSS will be used as a supplement to formal training in the Navy schoolhouse environment, onboard ship, and in shore-based facilities. It will be used to augment classroom training exercises, facilitate shipboard on-the-job training (OJT), and provide real-time troubleshooting and mentoring support while underway and during military engagements at sea. An overarching goal of the Aegis EPSS is to leverage the technical content contained in technical publications and IETMs, but to greatly improve on its content design, accessibility, and usefulness.

The analysis phase of the project included an assessment of past IETM and EPSS efforts in addition to a human performance analysis of the task and performer requirements. The following design approaches were recommended that would meet the requirements and improve upon past performance and design deficiencies:

- A new EPSS *content model*, combining standardized content with a custom user interface
- Complete integration of a synthetic equipment trainer within a performance-aiding context
- Creation of performance-augmented simulations, combining synthetic images with layered performance overlays
- Dynamic hypertext to enhance textual content
- Visualization techniques to support visual and spatial performer styles

EPSS Content Model

The EPSS Content Model will *standardize the content* and *customize the presentation*. This approach will allow human performance technologists to draw upon standard content objects to create unique task assemblies and context for the worker. By its very definition, performance support solutions should not be templated, reusable constructs. Instead they must provide the worker with a highly customized, personalized, and dynamic view of the work context and task progression.

Synthetic Trainer Integration

A number of synthetic maintenance training systems have been developed to provide high fidelity, free-play graphical models of weapon systems or equipment. These applications are designed to provide a maintainer with visual and/or aural cues that the maintainer would see and/or hear when interacting with a specific system. Within the standalone synthetic training application, each student has a synthetic model of the equipment and graphical models of all of the tools and test equipment that the maintainer uses to diagnose and repair the equipment. To date, these have resided as separate applications available in the schoolhouse and deployed environments; however, their utility makes them a valuable addition to an EPSS environment. The Aegis EPSS will fully integrate access to synthetic training interactions within the context of EPSS task support and not require the technician to navigate between separate, extrinsic support systems.

Performance-Augmented Simulations

One of the most powerful applications of simulation is to augment the performer's view of the simulated world with additional performance-aiding information. This new concept is called *performance-augmented simulation*, and is based on the pioneering work in augmented reality systems. In augmented reality, a context-aware application merges virtual graphical and textual information with the real world using a see-through display. Instead of merging with the real world, the Aegis EPSS employs a similar approach that merges virtual graphical and textual information (referred to as "performance overlays") with the synthetic trainer images. Simple directional or enhancement graphics and text is layered, or overlaid, on a synthetic environment image to help explain how to operate, maintain or repair the equipment using a minimal amount of text to convey task support information.

Dynamic Hypertext

The Aegis EPSS employs two forms of adaptive hypertext to tailor the information display to the specific needs and/or preferences of a performer and filter out content details that are outside of the users' current interest or beyond their level of comprehension. These methods are *expanding outlines* and *stretchtext*.

Expanding Outlines—This is an adaptive navigation technique that will provide an expanding and contracting outline, which will be used as a task list organizer, an equipment list organizer, and a procedural checklist. It provides a hierarchical view from which a selected item will drive the hypertext content display.

Stretchtext—This is a *conditional presentation* technique that will expand or collapse procedural paragraphs to reveal or hide details. For example, a particular paragraph will be collapsed in the default presentation if a technician is familiar with the information presented in this paragraph or if this information is not very relevant to the current context. The technician is free to expand and contract the text content at will.

Visualization Techniques

To help in reducing the amount of text necessary to support task performance, and to provide support for multiple performance styles, the Aegis EPSS project employs two visualization techniques: *alternate content views* and *smart schematics*.

Alternate Task/Equipment Views—The EPSS is being designed to enable the performer to easily navigate between a task-oriented view and an equipment-oriented view of the support content. Additional structure is being provided within these views to better support task completion. Omitting steps in the execution of a task sequence is a typical problem in the maintenance field (Brinkman, 2001). Therefore, the EPSS is being designed with short and clear instructions, in a numbered format with a maximum of five steps per instruction (which helps to remember the actions and keep track of the task when changing cognitive focus between the EPSS and the system being maintained) (Reason, 1990).

Smart Schematics—Network diagrams and schematics will be implemented through use of "smart schematics," which are 2D graphic picture-based schematics and network diagrams that have been transformed into interactive and collaborative graphical elements. Historically, most network diagrams and schematics use complex symbols, lines and abbreviations for visual representation and have typically been graphical pictures of the entire schematic or network. They do not provide realistic images and do not have interactivity with the schematic or among multiple users of a single schematic (for collaboration purposes).

The Smart Schematics approach has many benefits:

- Information and intelligence is able to be embedded into individual components and into the linkages among the components (e.g., electrical signal and power, data).
- Operational characteristics can be "scripted" into each element for realistic responses to external data inputs, user interactions or analytical/physical models,

- Interface tools can be integrated that can be used to “probe”, investigate, and annotate the embedded information within the schematic, expanding the capabilities of the remote troubleshooter.
- The user can fully manipulate and control the schematic, allowing the ability to move to higher and lower levels of detail by selecting a specific component or interface including a link to a full 3D interactive image.

CONCLUSION

In today’s defense environment, mission performance is achieved through human performance. While an IETM may provide for cost-effective conversion and allow for easier update and distribution as compared to paper manuals, there is still a considerable need to further refine the organization and presentation of technical information toward a work context that drives performance. Performance deficiencies that have been identified in today’s IETMs can be effectively addressed by evolving IETM design to a human-centered EPSS paradigm. This requires an enhanced understanding of human performance design; interface, context, and content design; functionality, standards, and architecture; and ultimately the impact on performance outcomes.

Accomplishing this shift will provide direct support to the military’s emphasis on the combined objectives of adequate operational readiness, force reduction, and reduced training for military maintainers.

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