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## The Advantages of Integrated IETMs in the Field

Ensuring that combat personnel can keep their weapons up and operating — no matter where they are, no matter what their mission.

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In today's military environment it is increasingly likely that soldiers, sailors, airmen and marines will need to work on their own equipment. Rapid-response deployments place military personnel in isolated environments that require them to fix advanced weapon systems — even though they haven't been formally trained for this job. They may not be familiar with maintenance techniques. They may not understand the task required. They may not know which parts they need. They may not know where to look (or even that they *should* look) for updated service procedures. They may be in a hostile environment. They're probably in a hurry. And they almost certainly have other things on their minds.

For troops in combat an Interactive Electronic Technical Manual (IETM) is only as good as the technology it's "written on." It's the underlying technology, as much as the content, that allows a quick response. And in the heat of battle it's what people do, not what they know, that counts most. That means that the right IETM can make the difference between pressing an advantage and being forced to fallback, between getting home and getting stranded.

The premise that drives advanced IETMs is simple: The people that use a weapon system must be able to fix it when it breaks. Combat personnel — not just technicians back at the maintenance depot, hangar or port — are increasingly the ones making repairs. Even back at base, factors such as force flexibility and the rapid rate of technology change make the idea of "keeping up" on every piece of hardware or software an impossible task. In fact, one of the greatest strengths of modern military equipment is also one of its greatest weaknesses. That's the ability to quickly adapt, while deployed, to account for current combat experience. The potential issues that arise from such extensive flexibility, of configuration, of mission, of ordinance, and the resulting impact on required service procedures are hard to document — and even harder for service personnel to follow. That's especially true for combat personnel who lack the detailed training to maintain the complex weapon systems on which they rely. That's why a fully integrated IETM is so important. It keeps everyone on the same page, and it keeps that page up-to-date.

What, then, are the likely consequences of *not* having an integrated IETM?

Those consequences can be disastrous. The mission might fail or be delayed. The wrong parts might be ordered — causing further delays. The equipment could be damaged or rendered inoperable. Personal injury could result. Friendly forces could be captured or killed. Multiply this over a large force and the impact is enormous. Today, hundreds of millions of dollars are wasted each year and a significant amount of military power is left on the sidelines. That's why it's important to know if your IETM works *before* you install it. The right question to ask is this: Will the technology *behind* the content deliver the right information in the right format to the right place right now to solve the problem *in front* of your soldier, sailor, airman or marine?

## Is Your IETM Integrated?

Looking over this list of consequences, one point stands out. An IETM is about a lot more than words and pictures on a computer screen. It's about making sure good actions happen and bad actions don't. It's the *quality* of action that matters; the content is a means to an end. That's why IETM technology is so important. It marries the content to the action, based on context. In the case of an IETM, context can be defined as what needs to happen right here, right now, given the current situation.

Context counts — both the user's and the organization's — and the IETM must support both. Let's start with user context. Today it's possible to fit all the knowledge that a weapons technician will ever need on a handful of DVDs. The question is: Out of all that data, which information is most relevant? And what about information that gets changed? Maintenance procedures change, parts change, designs change — not to mention that the weapon configuration, the combat scenario and the fault codes might change too. Service information is in a constant state of flux, so finding the right data can be difficult. Also subject to change: the technology available to the user. They could have access to a network, or not. They could be working from a laptop, a handheld, or a desktop. They could be in a forward deployment or in a repair depot. For any of these scenarios, if the required content is available but the user can't get it, the IETM is no longer an asset — it's a liability.

Equally important is the question of organizational context. An IETM doesn't exist in a vacuum. It relies (or should) on multiple applications and data repositories for service procedures, parts diagrams, available inventory and other resources — a select portion of which it presents to the user at any particular time depending on the task that's required. In fact, an integrated IETM should be considered the core of something new — an *integrated logistics application*. For example, instead of just listing which parts need to be replaced on a broken vehicle, it might also let you requisition those parts by clicking on them within the actual repair procedure. That one simple example is actually one of many advances that can be realized with an integrated IETM. And the significance of that advance is clearly recognized when a repair needs to be completed quickly.

But this example also helps explain the importance of supporting organizational context — i.e., how well the IETM integrates with the technology already deployed. In that regard, here are some questions to consider:

- Does the IETM mesh with the organization's data standards, legacy software, legacy hardware, personnel training, etc.?
- Will the IETM become a barrier to future (technology) innovation?
- Can the IETM build on legacy investments — taking advantage of SGML and other installed data formats?

Both user context and organizational context are rapidly moving targets. To be useful over the long term, IETM technology must keep pace. So, in the end, an integrated IETM has to get three things right: the content, the user context, and the organizational context — and it must do so in the face of rapid and unrelenting change on all three fronts.

## What Does the Military Want?

The importance of addressing these contextual challenges is important enough that the military has clearly identified them as requirements. In the IETM specification, MIL-PRF-87268A, the attention to context is clear. The specification states that:

The users shall have access to information relating to the technical content of the IETM, such as information on the weapon system itself (e.g., theory of operation or schematics) or assistance in

using of the authored procedures. The help function shall also permit *the user to access context sensitive help which applies to the user's current activity and situation*. It shall permit the user to access descriptive information to further explain technical points, define specific terms, or provide a fuller explanation of processes covered very briefly by the technical information. (Italics added.)

The Navy's CALS website also calls attention to context, this time in terms of equipment under service:

IETMs allow a user to locate required information faster and more easily than is possible with a paper manual. They are easier to comprehend; *more specifically matched to the system configuration under diagnosis* .... Powerful interactive troubleshooting procedures, not possible with paper technical manuals, can be made available using the intelligent features of the IETM display device. (Italics added.)

The DoD defines IETM functionality in terms of a "help hierarchy" with six layers or classes. The hierarchy starts out with "technology-free" content (i.e., Class 0) and extends to Class V, which describes an IETM as something approaching the integrated logistics application previously described. Rather than a computerized repair manual, what emerges might more appropriately be called a portable repair depot — a seamless environment of interlocking information systems, each optimized for its own functional role yet properly integrated to accelerate the service and support of complex equipment.

Class 0	Paper with multiple volumes not linked or integrated. Maintainer searches for data. High false removals rates probable.
Class I/II	Page turners and scrolling documents with indexing and some hyperlinking. Maintainer searches for data. High false removals rates probable.
Class III	SGML-tagged documents, some level of intelligence added, hyperlinking through linear structure. Maintainer searches for data. High false removals rates probable.
Class IV	Authored directly to database for interactive electronic output, authored for maximum viewing ease. False removal rates non-existent, hierarchical structure.
Class V	IETM linked to EQUIP and/or maintenance network, integrates with equipment diagnostics and expedites, troubleshooting, spares ordering and maintenance planning for increased equipment availability.

**Table 1: IETM Classes (see [www.ietm.net/dod.html](http://www.ietm.net/dod.html))**

Note again the attention to context. A fully functioning IETM is not a standalone document, nor an electronic version of one. It is a dynamic product encyclopedia that delivers service information and is deeply integrated with other systems — such as parts ordering, maintenance planning and equipment diagnostics. Unfortunately, none of these other systems was originally designed to work with the others or with any particular IETM solution. That's another burden that the IETM must carry: 1) get the content right; 2) get the user context right; 3) get the organizational context right; and 4) overcome barriers to meeting the first three requirements.

### **What Should You Look For?**

Knowing the four criteria for success is critical for judging a particular IETM. Even better is to know which indicators reveal whether those criteria are actually being met. Like the equipment they are intended to support, organizations with a highly effective IETM strategy typically realize some clear advantages. These include:

- Dramatically smaller logistical footprints
- Much higher states of operational readiness
- Disproportionately lower costs for equipment operation and repair
- Much faster deployment of weapon upgrades
- More capable/flexible personnel (rapidly implementing field experience)
- Rapid adoption of technology innovations (enabling new capabilities)
- Technology independence (adaptability)

Taken independently, each of these benefits is important, but taken as a whole these benefits work together to deliver significant value. For example, take logistical footprint — the amount of spare parts, people, and other resources needed to keep a piece of equipment working in the field. If fewer logistics resources are required then greater operational readiness will be achieved because smaller support units can be organized and deployed more quickly. Furthermore, the military will experience greater logistics flexibility because vital support equipment can be rapidly re-deployed elsewhere. Finally, deployment costs will decrease because fewer personnel and less support equipment need to be transported and maintained in-theater, and because weapons can be repaired in the field.

The fact is that service and spare parts have a huge impact on costs and performance. In the commercial world, the Aberdeen Group estimates that 8% of the annual gross domestic product of the United States goes toward service and spare parts for previously purchased assets like cars, aircraft, and industrial machinery. It's reasonable to assume a similar impact in the defense sector. Aberdeen goes on to say that industry is wasting billions of dollars on excess parts inventory due to the disconnect between service operations and inventory management.

The impact of disconnected systems goes beyond cost. Operational readiness can be significantly improved when information is integrated better and delivered faster. It is a simple fact that instant access to critical information improves the quality of decisions. When weapons need to be repaired quickly, service personnel can't afford to wait for the right information. Operational readiness is further enhanced when service and support information reflects experience. With an integrated IETM as new repair procedures evolve — whether in the field or at the factory — those can be automatically deployed to all relevant locations. Service personnel do not have to waste time figuring out new solutions to old problems — effectively reinventing the wheel — or trying to figure out if more current information exists. For most maintenance personnel, that would be a big improvement.

As an example, even though the maintenance and procedural manuals are located next to the aircraft, aviation technicians often spend 40% of their time away from the airplane looking for additional information that's needed to perform service. Today, some military organizations are trying to reduce the levels of maintenance support by half, which saves in training, organization, and personnel. It also improves operational autonomy, allowing a force that's been deployed to be completely self-sufficient. The right IETM will support a more generic workforce by providing “contextual” data to the maintenance personnel — whether they are warriors or mechanics.

In general, a failing IETM strategy is easy to recognize. It's one where equipment arrives at the service depot with a report of all suspected problems. A successful IETM strategy is one where equipment is fixed in the field, maintenance histories are updated remotely and, when complex repairs are required, the fault diagnosis is already in hand before the weapon arrives at the service depot — not because the soldier, sailor, airman or marine has trained to be a mechanic, but because the IETM took care of the paperwork. It guided the user to diagnose the problem in the proper context — recognizing the particular equipment model, type, configuration, symptom, mission and operating environment.

This has several advantages. For one, the diagnosis (or at least the reporting of symptoms) is more accurate if communicated immediately. (Symptoms may not occur later when the equipment arrives for service because the conditions that prompted the symptoms may no longer be present.) Another advantage is that the service depot will already have the correct spare parts in hand when the equipment arrives, which reduces the time needed to return the weapon to service.

Technology choices play an important role in developing the right IETM strategy. But what is most important is that the military *has* choices. No service should be locked into a particular vendor, or find themselves unable to exploit innovation, based on technology choices made in the past. That approach simply propagates the problems evident today and drives the organization further from the benefits of a true, common off-the-shelf solution (COTS).

So, what kind of IETM technology *should* organizations choose in order to acquire these benefits? That's next.

### What's Under the Hood?

As previously stated, an integrated IETM empowers untrained personnel to service a variety of equipment in potentially difficult environments. That in turn requires the IETM to handle four things well: Diverse content, user context, organizational context, and technology barriers. Given those capabilities, an integrated IETM delivers a new model of equipment maintenance and repair. It's a model that offers significant benefits to both warriors and military planners — including improved readiness/effectiveness, and lower support/logistics costs.

To assure themselves of those benefits, military planners need to look under the hood of the technology they buy. Here's what they should expect to find:

- Scalable architecture
- Evolving documents
- Standards compliance

**Scalable architecture.** Probably the most important attribute an IETM can have is scalability. Scalable simply means that IETM performance remains acceptable regardless of the size of the implementation. In an IETM solution, the idea of “size” can mean many different things, some of which might not be immediately obvious:

- Number of users
- Types of users
- Types of media
- Amount of content
- Types of content
- Number of content updates
- Types of content updates
- Frequency of content updates
- Number of integrations
- Types of integrations
- Number of weapons systems/equipment
- Types of weapons systems/equipment
- Number of deployments
- Types of deployments (availability of bandwidth)
- Frequency of deployments

A scalable architecture allows you to grow the size of your IETM with respect to any of these factors virtually without limit. In a non-scalable architecture, you typically reach certain load thresholds beyond which the application no longer works or becomes prohibitively complex or expensive. Performance may degrade below a tolerable level, the application may become untenable to deploy or manage, or it may even crash. When that happens, per-user costs spike and operational readiness decreases because the organization generally has to replace the old application with a new one — with all the reengineering and data conversion that entails.

The reason some architectures are more scalable than others is because they employ an *n-tier, web-based deployment model*. N-tier means the application is logically partitioned into discrete blocks of functionality — data sources, business logic, and presentation. Web-based means that these blocks do not have to be “hardwired” together but can interact with each other over an IP network, such as the Internet. The

advantages of n-tier, web-based include:

<i>Thin client</i>	A thin client architecture eliminates proprietary code from the user's laptop, PC or handheld. That makes it easy to add users and inexpensive to distribute content. It also makes it easy to change business logic, data sources and functionality because those changes are implemented on the server, not spread across all clients that use them.
<i>Shared Middleware</i>	Middleware such as J2EE provide services that are common to application blocks, such as message services, data caching, and channel management, to name a few. By using shared services, the application becomes more stable because it doesn't have to provide and maintain custom versions of these services.
<i>Plug &amp; Play</i>	As application loads grow, power needs to be added — CPUs, database capacity, network links, and so on. In an n-tier, web-based model, these additional resources can be specifically targeted at whichever application blocks need them most. Making it easier to optimize performance and minimizing the hardware footprint and cost.

**Evolving documents.** The presentation of service information should adapt dynamically to reflect user and organizational context. Here are some benchmarks:

<i>Context sensitive delivery</i>	Information relevant to each step of the diagnosis procurement and repair process is filtered and presented based on a specific piece of equipment. Related information is propagated across multiple IETM views (such as between parts lists and maintenance tasks). Neither the user nor the IT department should need to tell the IETM how or where to make these types of logical connections.
<i>Incremental updates</i>	The ability to update service information easily and often is a requirement. An IETM must support the addition of new content outside of the usual 1-2 year revision model. Repair procedures in a maintenance manual should include information contained in the latest service bulletins — even when issued months after the manual was released.
<i>Embedded data</i>	Some text in a repair procedure should be treated as data in a parts ordering or inventory system. Since these other systems may not know how to interpret a maintenance manual, responsibility for that translation lies with the IETM.
<i>Device portability</i>	An IETM should adapt content to different I/O devices, like laptops and handhelds. That could mean that a complex diagram that won't display well on a handheld might be excluded from the default view of a repair procedure — but would be included when viewed on a laptop or PC.

**Standards compliance.** Surprisingly, some vendors don't fully support web, data and interchange standards even though it is those very standards that make many of the benefits of an integrated IETM possible. They will, for example, utilize a proprietary web browser to access server-based functionality or develop proprietary interfaces and messaging systems to connect to other applications. This approach has many drawbacks for the military:

- Programs are locked into a single vendor
- Special training is required to support proprietary browser code
- Changes in applications, user interfaces and government standards (e.g. DTDs) require browser or application upgrades
- New IETM functionality takes longer and costs more to deploy to the field
- System integrations are costly and time consuming
- Migration to new systems is costly and time consuming

All these limitations oppose two key objectives of an integrated IETM — to increase readiness and reduce total cost of ownership. But browsers are just one example where IETMs can leverage standards. Some standards are defacto, like Internet Explorer, and are based on market dominance. They tend to exploit traditional COTS advantages. Other standards are committee-based, like XML, and exploit advantages similar to COTS, because they are so widely supported in the commercial marketplace.

### **IETMs as Strategy**

Clearly, military planners should expect more from an IETM than what they've been getting. The rate of change of technology, and the resulting complexity of modern weapon systems, will continue to accelerate. However, in today's rapid-response environment, the ability to deploy forces that can operate with a minimal logistics footprint is crucial. Soldiers, sailors, airmen and marines must be able to maintain and repair their own equipment. Malfunctions should be recognized sooner, diagnosed more easily and resolved faster. Weapons upgrades should be rolled-out quicker, implemented less expensively and require less training. While reducing the number of equipment failures is always a priority, combat is abusive to military hardware. Therefore, the right IETM strategy should reduce repair times, troubleshooting errors, parts misorders and inventory costs. Service personnel should be able to diagnose and fix more equipment in the field — even for problems they have not been previously trained to diagnose or fix. Service information must be made more accessible to today's warriors but it must be filtered to better reflect what they actually need to know when they need to know it. With the right IETM strategy, innovation and change come to be viewed as advantages, not as impediments.

Implementing an integrated IETM can be like finding the higher ground in battle — a strategic advantage that opens up new vantage points and new possibilities. The difference lies in the extent to which the technology enables, facilitates, and then guides action — both for the user and the organization. At a time when the military is being asked to do more with less, this is a strategy that must be considered.