

Independent Validation and Verification Task in Year 2 R-TOC

Background and Relevant Literature

The plan for conducting the Independent Validation and Verification of the IDA Cost-Benefit Analysis (IV&V ICBA) of the Reduction of Total Ownership Costs (R-TOC) Bridge project derives from the stated goals and external assessments of the R-TOC program along with established methodologies for IV&V and cost-benefit analysis. To ensure methodological transparency and inform readers of this study who might otherwise not be familiar with these methods, a review of the relevant literature is provided here.

1. R-TOC Program Background: Guidance and Best Practice

The Under Secretary of Defense for Acquisition, Technology and Logistics (USD[AT&L]) administers the R-TOC program, which was initiated in 1997. The motivation for the program was the rising cost of maintaining existing equipment that resulted in the depletion of DoD's equipment modernization accounts. Key to the evolution of the R-TOC program were 30 pilot projects (10 pilot projects awarded to each Service). The purpose of the R-TOC was elaborated in a 1999 memo from the Under Secretary of Defense for Acquisition, Technology and Logistics (USD/AT&L) clearly stating that the purpose of R-TOC was to *maintain or improve current readiness while reducing O&S costs* (Gansler, 1999). The memo instructed the Services to base their pilots on three general R-TOC cost saving areas:

- Reliability and maintainability improvements
- Reducing supply chain response times
- Competitive sourcing of product support.

The results of the pilots formed the basis of two reports produced by IDA in which metrics, methodologies and best practices were identified and employed in meeting these program goals (Reed & Romer, 2008) (Reed & Reed, 2003).

Reed & Romer (2008) draws conclusions on 15 Special Interest Programs in addition to the 30 Pilot projects. These documents

- Emphasize the criticality of cost-benefit analysis (CBA) in any successful R-TOC project
- Raise issues about the difficulties and need to standardize metrics and methods in conducting CBA, especially the need to quantify and provide metrics for readiness improvements
- Suggest the need to use the previous two insights to address the challenges of full scale roll-out of successful R-TOC projects to the full Navy or other services.

2. Independent Validation and Verification

As explained in section 1.2 above, the term V&V as used in this study is non-standard, however the standard usage may directly bear on the development of Bridge technology. So this section offers a brief review of the V&V literature.

V&V, in its use as a systems engineering or quality assurance technique has prompted the definition of standards to ensure consistent application to a wide array of systems, products and services. Most relevant to this study is the *Institute of Electrical and Electronic Engineers (IEEE) Standard for Software Verification and Validation* (IEEE Std. 1012-2004), which defines international standards for both technical and management-based software development activities. These activities map directly into ISO/IEC 12207 Life Cycle Processes, i.e., acquisition, supply, development (incl. concept, requirements, design, implementation, test, installation, and checkout) operation, maintenance, organizational and other supporting. Standard practice applies V Other V&V processes apply to metrics and reusable software.

IV&V processes are mandated for federally subsidized system information technology projects and they loosely conform with IEEE 1012. Comprehensive assessment of the project processes and deliverables, concurrent reporting to state and federal stakeholders are among the standards-based requirements. Under federal regulations at 45 CFR 307.15(b)(10), an IV&V requirement is triggered for certain state automation system. Finally, DoDI 5000.61 for Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A) is DoD's instruction that implements policy, assigns responsibilities, and prescribes procedures for the verification, validation, & accreditation (VV&A) of DoD models, simulations, & associated data. The "M&S Guidance for the Acquisition Workforce" and the Defense Acquisition Guidebook (DAG) Chapter 4.5.8 both address V&V for modeling and simulation software (see <http://www.acq.osd.mil/sse/docs/M-S-Guidance-Acquisition-Workforce.pdf>).

The application of the formal definition of IV&V to the Bridge will occur with implementation, including piloting and is outside the scope of this task. However, cost estimates and metrics should be adjusted as the implementation evolves and V&V are applied to the design and the Concept of Operations. As the Defense Acquisition University states "Verification and validation of product design, early in the development lifecycle, is necessary to ensure that design changes do not adversely impact the production process and program cost. The appropriate mix of design verification and validation activities (e.g., critical design review) must be balanced with the program goals (e.g., cost, schedule) and product characteristics / requirements (e.g., complexity, safety) to ensure that technical problems are uncovered early and do not lead to costly retrofits and redesign of the production versions since these lead to increasing the product cost and significantly moving out the schedule" (DAU-BPC, 2010).

Cost control must be exercised through development process by estimating, tracking and comparing with the original cost-benefit analysis. Deviations from expected may signal a defect or a misestimate. In either case, the earlier corrective action can be undertaken in the development phase, the more likely will be overall product cost containment.

3. Cost and Benefit Estimation

Several key sources provide the basis for the cost-benefit analysis methods used to validate and verify the ICBA. The cost estimation and analysis techniques used in this study will conform to those recognized by the Society of Cost Estimating and Analysis (SCEA), the leading professional society for cost estimators. SCEA methods are provided in their Cost Estimating Body of Knowledge (CEBoK™), which serves as a desktop reference and training courseware for SEAS certification (SCEA, 2010). Another source used in this endeavor includes the U.S. Government Accountability Office developed a Cost Guide (GAO, 2009). GAO's Cost Guide provides a consistent methodology based on best practices on oversight of the government's stewardship of public funds and support the Office of Management and Budget's (OMB) capital programming process. A twelve step process for high-quality cost estimation is offered. The attention directed at cost estimation stems from the fact that cost estimation is a measure of government program performance. Moreover, cost estimation is critical for the evaluation of new technologies, such as "The Bridge", as well as for the management of costs through the system life-cycle. Additionally, cost estimation is an essential requirement of an R-TOC project.

The management of a cost estimate involves continually updating the estimate with actual data as they become available, revising the estimate to reflect changes, and analyzing differences between estimated and actual costs—for example, using data from a reliable earned value management (EVM) system.

4. Work Breakdown Structure Analysis

The original CBA relied upon site visits, interviews with subject matter experts and review of documents suggested by them to verify and validate the IDA CBA. The original thinking appeared to the process information associated with generating technical manuals and training content would serve to estimate costs.

As a result of the decision to, first, limit the site visit to one site, Panama City, and then to eliminate the site visits altogether, the decision was made to reconstruct workflows for training content from available Navy guidance documents, such NAVEDTRA 130, 131, 136 series, ILE Content Developer's Handbook (MPT&EC10SWIT, various NETC instructions, etc. The document, *Derivation of the Implied Work Breakdown Structure and Its Comparison with the IDA Work Breakdown Structure*, provides full information on these documents, the methods used, and the analysis. This document exists as a self-contained unit as it provides results and analysis.(NAVEDTRA-136, 2010)

5. Uncertainty Analysis

All life has uncertainties, and the world of modeling and analysis is not an exception. Cost estimation effectively relies on a model of reality, which defines the costs, e.g., different components and parameters. Models such as Work Breakdown Structures and their associated cost elements are considered best practice for estimating the costs of acquiring programs and managing them over their life cycle (GAO, 2009). These models are necessarily abstractions of reality and uncertainties in estimation can be expected in all three aspects of program management, namely, cost, performance and schedule across all life-cycle stages.

Examples of uncertainties associated with program management are:

1. Estimating the cost of creating a new technical manual using current systems
2. Estimating the how long it will take for an engineering change proposal to propagate into the appropriate training content using the current systems.
3. Estimating the efficacy of a new process.

These examples highlight the need to address uncertainty in IV&V task of estimating the return on investment of introducing the Bridge to integrate the technical information and training content production processes. In examples 1 and 2, there is likely historical data on which to base the estimate, possibly even a quantified probability distribution, which is referred to as risk. The third example poses additional uncertainties because a new process, i.e., the Bridge is introduced, for which no historical data exist, and which may impact the efficacy of other processes in the systems.

The purpose of introducing uncertainties and uncertainty analysis into cost estimation is to:

- Convey to decision makers the essential fact that all estimates are, in fact, uncertain.
- Ensure that decision makers are not misled into believing that point estimates of cost are more certain than they are, and thereby be misled into a false sense of security of their exactness or precision.
- Quantify the risks that are integral, but perhaps heretofore unstated, to the analysis
- Establish the foundation for developing risk mitigation strategies.

GAO has a twelve step process for high-quality cost estimation, which begins with a step for generating single point estimates but follows with a step for risk and uncertainty analysis (GAO, 2009). Organizations dealing with high-risk, large-scale weapons systems acquisition demand the use uncertainty analysis for cost estimation (NATO-RTO, 2007).

The findings of a RAND Project AIR FORCE study of various cost uncertainty assessment methodologies and their effect on total portfolio of programs resulted in the recommendation to analyze cost estimation uncertainties using various, and preferably a combination of historical, sensitivity, and probabilistic methods (Arena, et al., 2006).

A classic approach to quantifying and thereby understanding uncertainties is called Monte Carlo Analysis. Monte Carlo Analysis is actually a class of methods, an introduction to which can be found at http://en.wikipedia.org/wiki/Monte_Carlo_method). Below are three aspects of Monte Carlo Analysis.

- Monte Carlo methods are a class of computational algorithms that rely on repeated random sampling to compute their results. Monte Carlo methods are often used in simulating physical and mathematical systems. (from en.wikipedia.org/wiki/Monte_Carlo_analysis)
- Monte Carlo is a technique that allows assessment of the consequences of simultaneous uncertainty about key inputs, taking account of correlations between these inputs. (from www.dfpni.gov.uk/eag-glossary)
- Monte Carlo Analysis predicts how scenarios may work out given any number of variables. The process doesn't actually generate a specific answer, but a range of possible answers. (from pmpbank.googlepages.com/glossary)

6. Cost-Benefit Analysis of Adopting Information Technology Standards

Numerous examples exist of the application of cost-benefit/total return on investment analysis to the adoption of standards. Standards are specifically put forth as mechanisms to control cost by permitting interoperability, improve health, safety and the environment, limit risk, lower cost, improve efficiency – and other mechanisms for enhancing the quality of a product, system or service. Examples can be found on machinery/equipment, medical records systems, new drug testing, etc.

Thus far no cost-benefit analysis of the technical specification and training standards has been found in the literature. This work could therefore advance the use of cost estimation and provide a valuable analytical framework to programs considering the adoption of standards-based integrated production of technical manuals and training content.

Arena, M. V., Younossi, O., Galway, L. A., Fox, B., Graser, J. C., Sollinger, J. M., et al. (2006). *Impossible Certainty: Cost Risk Analysis for Air Force Systems*.

DAU-BPC (2010). DAU Best Practices Clearinghouse, Proper verification and validation of product design Retrieved 11/15/2010, from <https://bpch.dau.mil/Pages/PracticeView.aspx?pid=618&b=1>

Gansler (1999). *Future Readiness*.

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ADDENDA on Instructor-led Training and Computer- Based Training

ADDENDUM 1

The issue of instructional delivery modes may seem to be a trivial side issue, a distraction, to the pedagogical and cost-benefit questions that this work addresses. That, however, is not the case. The literature is replete with a robust discussion of the pros and cons of the two modalities. In reviewing the literature and reproducing some of these arguments below, we are laying out our conclusion that several ILT – versus – CBT issues need to be addressed and resolved as necessary and integral parts of the larger RTOC effort.

Definitions are always in order when one is disentangling issues. From Wikipedia [<http://en.wikipedia.org/wiki/E-learning>], we have:

- *Computer-Based Training (CBT)*
 - *E-learning comprises all forms of electronically supported learning and teaching. The information and communication systems, whether networked or not, serve as specific media to implement the learning process. The term will still most likely be utilized to reference out-of-classroom and in-classroom educational experiences via technology, even as advances continue in regard to devices and curriculum.*
 - *E-learning is essentially the computer and network-enabled transfer of skills and knowledge. E-learning applications and processes include Web-based learning, computer-based learning, virtual classroom opportunities and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio.*
 - *Abbreviations like CBT (Computer-Based Training), IBT (Internet-Based Training) or WBT (Web-Based Training) have been used as synonyms to e-learning. Today one can still find these terms being used, along with variations of e-*

learning such as elearning, Elearning, and eLearning. The terms will be utilized throughout this article to indicate their validity under the broader terminology of E-learning.

- *Instructor-led training (ILT)*
 - *The practice of training and learning material between an instructor and learners, either individuals or groups. Instructors can also be referred to as a facilitator, who may be knowledgeable and experienced in the learning material, but can also be used more for their facilitation skills and ability to deliver material to learners.*
 - *ILT is an effective means of delivering information, as it allows for real-time feedback, questions and answers, manipulation and changeable delivery to suit the needs of learners in a real-time environment, and a learning environment can be created by the instructor's style.*
 - *Instructors may deliver training in a lecture or classroom format, as an interactive workshop, as a demonstration with the opportunity for learners to practice, or even virtually, utilising video-conferencing tools; and the instructor may have facilitation and teaching skills, in which they can utilise different methods to engage learners and embrace different learning styles.*

The New York Times, in an article on February 6, 2011, entitled "Online Courses, Still Lacking That Third Dimension" [[http://www.nytimes.com/2011/02/06/business/06digi.html?_r=1&sq=online teaching&st=cse&scp=1&pagewanted=print](http://www.nytimes.com/2011/02/06/business/06digi.html?_r=1&sq=online%20teaching&st=cse&scp=1&pagewanted=print)] argues that "There is something motivating about the student's relationship with the instructor — and with the student's relationship with other students in the class — that would be absent if each took the course in a software-only environment. Those relationships — with humans in the flesh — help students to persevere. Online courses are notorious for high dropout rates." And further, "What is sacrificed when classrooms disappear, the place where good teachers do not merely 'deliver content' to students but wake them up, throw them on their feet and pull the chair away? Where ideas can become intoxicating, where an instructor's ardor for a subject or a dimension of the world can be contagious? Where scientific, literary, ethical or political passions are ignited?"

[http://www.technical-vocational-schools.com/online_classroom_learning.aspx] discusses some general pros and cons of the ILT and CBT modalities, beginning with "At first glance, online education might seem like an easy and undervalued way of obtaining... education. However, after

years of testing and constant studies, online learning is gaining acceptance by the education industry as an acceptable and productive way of obtaining your education. One such study suggests that online learning is actually a more efficient and effective way for students to learn. "

The views from this source are summarized as "The truth to the matter is that there are advantages and disadvantages to every type of learning environment. It is best to use the advantages that each method offers to their fullest extent. It appears from the initial studies, that a combination of online and classroom learning to convey subject matter to students will be the best teaching method. However, in some instances the inconvenience of maintaining a consistent school schedule prohibits potential students from furthering their education. Learning also highly depends on the individual's motivation to learn. So it still comes down to the effort that the students put into their education that ultimately determines how much they will retain and how beneficial the overall experience was to their future career"

Below are some of the pros and cons of online learning versus learning in a traditional classroom setting.

- Online Learning
 - Pros
 - **Allows for learning in distant or disadvantaged locations:** Online education is easy to access and provides a convenient way to obtain course materials such as homework, exam schedules, test scores and more. Most online learning environments are accessible from a standard internet connection and typically require average home computer system requirements.
 - **Facilitates easy information transfer:** For most online schools, all course information is obtained by browsing the internet and sending/receiving email. This instant and secure transfer of information provides a convenient way for students to communicate with their instructors and fellow classmates. Some classes participate in chat sessions on a weekly or even more frequent basis. This provides a means for students to interact with each other while learning a particular subject thus enhancing the overall learning experience.
 - Cons
 - **Changing technology may create barriers to accessing learning environments:** As with new teaching methods, online learning has

faced much criticism from many sources as they claim it has devalued post secondary education and will reduce the effectiveness of obtaining quality career positions by obtaining higher education. These skeptics claim many existing barriers to effectively learning complex subjects in an online-only setting. They also feel that it isolates the students from one another as well as their instructor reducing the overall value of taking the course.

- **Limited understanding of effective teaching methods due to youth of online learning:** Due to the youth of online learning, there has been little research conducted to evaluate the teaching methods or the effectiveness of student comprehension through an online-only learning environment. Some programs also offer a combination of online and classroom style teaching for the same course. This allows for the benefits of both types of learning to be realized.

- **Classroom Learning**

- **Pros**

- **Provides interactive classroom setting that promotes the open exchange of ideas:** Having numerous students learning in the same classroom has the added benefit of allowing students to exchange ideas and questions with one another providing another valuable learning medium that online environments cannot replicate. First-hand interaction with the educating professor also allows for ideas to be exchanged freely and without any communication barriers.

- **Cons**

- **Encourage passive learning:** Depending on the level of interaction in the classroom setting, shy students may be allowed to attend classes without providing alternative ways to communicate ideas. Forcing students to learn by vocal exchange with a professor may limit their ability to learn.
- **Ignore individual learning differences between students:** Classrooms environments tend to group students together in large number often making it difficult for instructors to isolate learning deficiencies and provide the necessary close attention that individuals may need to learn. Online classes allow for a more individual perspective from the professors standpoint due to most of the communication being easily handled through email and chat.
- **Neglect problem solving, critical thinking, and higher order learning skills:** The classroom setting can also hinder ones ability to learn by allowing other, more vocal, students to dominate the bulk of the discussion environments. Quieter personalities are limited in their

communication options for exchanging ideas and information.

[\[http://hubpages.com/hub/Pros--Cons-of-distance-learning-online-classes\]](http://hubpages.com/hub/Pros--Cons-of-distance-learning-online-classes) discusses the questions to ask yourself before determining whether ILT or CBT is the better learning environment for a particular learning task. These questions include:

- Are you a visual or auditory learner?
- Do you need direct access to your instructor?
- What is the cost difference?
- What is the supply difference?
- Are you on the go with your current job?
- Are you looking to relocate during the semester?

The same source says compares the environments as follows:

- **ILT**
 - **Advantages:** the immediate presence of the teacher, providing opportunities for material repetition, interaction with other classmates, consistency afforded by a preset time for class.
 - **Disadvantages:** untethered presence, avoidance of poor teachers, avoidance of the usual classroom distractions, flexible timing for learning.
- **CBT**
 - **Advantages of online classes include:** the freedom to attend when it's convenient.
 - **Disadvantages :** the cost can sometimes be more, there may be more papers and assignments to make up for the lack of in-class time, there are still attendance rules, paying for portability may increase your monthly bills, reading on the computer screen can be a headache, you'll likely never see your instructor or classmates face-to-face, there is no control over groups you might be assigned to work with initially.

ADDENDUM 2

Instructor-Led Training (ILT) Versus Computer Based Training (CBT)

The purpose of training in the military is to enhance the human performance needed for successful operations.

Background

In the years prior to computers the use of classroom instructors was sometimes enhanced by tutors with class size frequently being considered a metric for the quality of training – the lower the class size the better the training. The literature is rich with examples regarding the value of one-on-one tutoring in the learning process. One example developed by J. D. Fletcher, IDA from earlier work by Benjamin Bloom in 1984 suggests “one-on-one tutoring, with instructional time held constant, can raise the performance of mid-level 50th percentile students roughly to that of 98th percentile students.”¹ Research also shows computer based, or distance learning applications allow an individual to proceed at their optimal (or preferred) pace while allowing concentration on those areas of need, much like the use of tutors in training.

Instructor-led training normally reaches back to books or in the military to Field Manuals, Technical Manuals, Operators Manuals, etc for instructional material and learning content. The ILT content delivery method has been practiced for centuries in both education and training in the classroom. It turns out that books are a relatively low cost medium with content that can be accessed by students, who can control their access to the available content for reference or preparation for classroom instruction or training exercises. However it has been found that a typical learning audience has individuals who have a wide range of knowledge or familiarity in a given area. In some cases the individual might have significant prior knowledge of the content and is thus “held back” by the pace the instructor must present the material for the class as a whole. Although books as learning resources are hard to beat, they are similar to the classroom instruction in that the author has tailored the content (and presentation of content) to the level (and sequencing) assumed to be most suitable for most readers. Another disadvantage of books is that in a rapidly changing world, the knowledge may quickly become stale. The military’s technical manuals may be in a constant state of change as product improvements are made to the base system, or new maintenance tools or techniques are introduced. How then can we improve on books as the reach back for ILT? There are many today who advocate the use of computers as a way to keep reference materials up-to-date and facilitate access at the optimal rate for any given student.

The underlying premise in the DoD Advanced Distributed Learning (ADL) initiative began with the issue of the impact of technology on learning content. The frequently

¹ J. D. Fletcher, *Research Foundations for the Advanced Distributed Learning Initiative*, IDA Document D-4118 (Alexandria, VA: Institute for Defense Analyses, August 2010) p.3.

cited example concerns classroom instruction, involving 20-30 or more students, compared with individual tutoring involving one instructor for each student.² The use of computers is seen as a way to provide surrogate tutors. There are many benefits to the use of computers in any variety of ways to enhance the learning experience – either in or outside the classroom in the more traditional ILT environments. Central to this discussion is the capability of computers to adapt both the sequence, content, and type of operations they can perform based on the conditions at any given time – or the given level of proficiency demonstrated by the student. Computers can ultimately adapt the content, sequence, type, difficulty, granularity, etc. of learning content to learners and other users based on their assessment of the individual’s student’s needs, background, objectives, interests, and values.³

Examples

A number of examples can be found citing the advantages and disadvantages of CBT applications in a both military and business environments. Two examples are offered here, one from the Navy and one from an industry study. The first is from the Naval Submarine School and highlights advantages of CBT to permit flexibility for the schoolhouse and the students, and also as used in automated remediation for the slower learning students.

“The benefits of implementing adaptive CBT in the Submarine School range from possible time savings in specific curricula to automated remediation and instruction. Manpower savings will permit Submarine School to pursue implementation of a Distance Learning support division comprised of experienced subject matter experts who have instructional expertise in front of a class and as CBT authors. CBT cannot replace the instructor completely. Students asserted uniformly that the face-to-face communications were at times critical for the understanding of particularly complex concepts. Training via CBT provides exceptional flexibility to both the schoolhouse (in terms of resource scheduling) and to the student (to learn at his convenience).”⁴

The following example reinforces the earlier observations on flexibility and access offered by CBT from a positive perspective, but this example also looks at disadvantages that are relevant for off the shelf instructional packages. The significant costs of customizing learning content to specific organizations or audiences is seen as an impediment to wider use.

Computer Based training (CBT)

Advantages:

² Ibid.

³ J. D. Fletcher, *Remembrance of Things Past: The Individualization Imperative*, Paper delivered at the American Educational Research Association (AERA) in Chicago, 2007. Not published.

⁴ Birchard, Marcy; Dye, Charles; Gordon, John, *An Empirical Evaluation of Sonar Courseware Developed with Intelligent Tutoring Software (InTrain[TM])*, Naval Submarine School, Groton, CT, 2002.

Cost: Depending on the number of employees to be trained, CBT can initially be the cheaper

choice, without a customization effort. [IDA research extrapolating from an earlier study shows annual reductions in costs that would result in instruction time in specialized skill training were reduced by 30% for various percentage of students in residential training.]⁵

Student flexibility: Students have the flexibility to work at their own pace and fit training around busy schedules.

Remote offices can be trained without travel and loss of time at work.

Consistent training: All employees receive consistent instruction by learning the same software the same way.

Disadvantages:

Startup costs: Buying CBT programs and then customizing them for your particular company

is expensive.

ZZZZZ -- Boring! There is no interaction in this learning process.

"But I don't get it?" With CBT there is no one to answer questions. A student can get lost very

easily without an instructor available for direction.

No flexibility: CBT offers only one way of teaching. Many students don't pick up key concepts

and become lost.

Computer-phobia: Computers intimidate some people. It requires very disciplined individuals

to work through the lessons in a way to retain the knowledge for use at work.

When asked to learn on their own, employees tend to be more relaxed and do not take the training as seriously.

Instructor-led training (ILT)

Advantages:

Live interaction: An instructor is able to answer questions, give praise, motivate and help students.

Energy and enthusiasm: "Live" instructors can pass on their energy and enthusiastic attitude

to students.

Motivation: A good instructor will motivate students to learn by presenting ways of saving time

when working with the software.

"But I really don't get it?" Instructors can be compassionate and share real life success and

failure stories. Experienced instructors can work with a problem and find different ways to

teach students who are having difficulties.

⁵ Angier, B., Fletcher, J.D., & Horowitz, S. (1991) *Interactive Courseware and the cost of individual training* (IDA Paper P-2567), Alexandria, VA: Institute for Defense Analyses.

Facts are facts: Overall, it is proven that people learn better with face-to-face personal interaction. One-on-one teaching can instill confidence and keep students on a path to success.

Disadvantages:

There can be variation among individual instructors and schools in terms of the methodology

employed in the classroom and effectiveness of the presentations.

Learn it today, teach it tomorrow: At times, instructors are told they have to teach a "new"

program and must be ready the next day. They wind up being only one step ahead of their students.

Summary

Deciding when to use CBT or ILT can be difficult. One solution is to use both methods. CBT

can be a tool used by instructors, similar to the use of manuals, white boards and projectors.

Having a student learn with the computer before attending an instructor-led class can enhance the learning process. Students will know what they understand and what they need

help with to maximize their computer training experience. Because people learn in different ways and at different levels, some will react well to CBT while others need direction, examples accentuated with a live presentation and customization to make the training effective. The majority of students, including most non-technical individuals, need some degree of face-to-face instruction to understand and retain the knowledge in order to apply it to their work environment.

Instructor-led training offers a technique that personalizes learning for thoroughness and improved rates of retention. Instructors can offer personal insight on how to make applications work best for employees.

While CBT offers some degree of built-in "intelligence," it cannot anticipate students' questions or determine how well an individual understands the information presented.

Computer-based training, instructor-led training or both? Remember, what is right for your

company may not be right for another. Overall, the initial cost of the training is only a small part of how your company is affected by the decision."⁶

It would appear, that if feasible, the blended approach of incorporating CBT in an ILT classroom environment (real or virtual classrooms) would seem to be most effective. Where possible the up to date reference manuals should be provided through on-line

⁶ Greenberg, Marilyn, *Computer training choices: Instructor-led versus computer-based*. Fairfield County Business Journal, 03/12/2001, Vol. 40, Issue 11, p12, 2p, Fairfield, CT, 2001.

access. The combination of pre-screening tests for students and scalable on-line content to match their needs should permit a more efficient and effective delivery of learning content.

