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Chapter 10

True Believers: Digital Game-Based Learning in The Military

We KNOW the technology works, we've proven it over and over again, and we just want to get on with using it.
-Don Johnson, the Pentagon

Adopt the role of Joint Force Commander and tackle ten realistic scenarios to hone your knowledge of doctrine. Adjust friendly and enemy forces in four selectable scenarios to test varying military possibilities.
-JFE Training Game Box

"Boy, can't you see I'm flying here? Go away"
-an Air Force General in a simulator to a trainer
(Quoted in *Training* Magazine)

Business people are slowly "getting it." Schools "get it" here and there. But the U.S. Military "gets it" *big time.* The Military has embraced Digital Game-Based Learning with all the fervor of true believers. Why? Because it *works* for them. And trust me, the guys in charge of training at the Pentagon are a very sharp group. They have seen and evaluated *everything*.

"We're a few standard deviations ahead of most, including those in industry, yet most people don't know who we are" says Michael Parmentier, head of the Readiness and Training unit of the Department of Defense at the Pentagon. [1]

The military's training mission is a daunting one. It has to train 2.4 million men and women in the four services (army, navy, air force, marines) plus almost another million civilian employees [2] to work as individuals, as teams, as units, and in combination to meet all sorts of unforeseen and difficult objectives around the world under very high-pressure conditions. It has to train its officers to lead, manage and command. It has

educate military dependants. Turnover is huge enough to make any corporate executive shudder and among those who stay, job change rapid, particularly at the officer level. Strategy, tactics and equipment are all continually evolving at a rapid pace. Extremely sophisticated technology is playing a greater and greater role. And the training has to be fast. No time for lollygaging around – this the Army! (or the Navy! Or the Air Force! Or the Marines!) We've got missions to perform and they'd better be done correctly!

Not only are the branches extremely complex organizations themselves, they need to be coordinated to work together in most mission situations. The services have a combined incoming cohort of a quarter of a million enlistees [3] to train each year in military training basics and then in over 150 military occupational areas and literally thousands of specialties and sub-specialties. They need to train for war, yet increasingly they need to train for peacekeeping missions, as America's role in the world changes. Finally, their incoming recruits are not seasoned adults, with work experience and habits on their resumes, but typically high school graduates and non-graduates, most of whom have never worked before. Molding these people into a well-trained force is a staggering job, and the military approaches it with the purpose, and budget of a major mission. The combined training budgets of the armed services are about $18 billion, including $6 billion institutional training, $12 billion operational (unit) training, and excluding trainees salaries. [4]

It is precisely because of this mission that the US Military is the world's largest spender on and user of Digital Game-Based Learning. The military uses games to train soldiers, sailors, pilots and tank drivers to master their expensive and sensitive equipment. It uses games to train command teams to communicate effectively in battle. It uses games to teach mid-level officers (local Commanders-in-Chief or CINCs and their staffs) how to employ joint force military doctrine in battle and other situations. It uses games to teach senior officers the art of strategy. It uses games for teamwork and team training of squads, fire teams and other units; games for simulating responses to weapons of mass destruction, terrorist incidents and threats; games for mastering the complex process of military logistics; and it even uses games for teaching how *not to* fight when helping maintain peace. In fact, there seems precious little that the military *doesn't* use some form of game to train. Let's start with an example.

Joint Force Employment (JFE)

The day I arrived at the Pentagon for a meeting with the Training and Readiness Unit of the Assistant Secretary of Defense, the guys in the shop were eager to show me the first copies of a brand new game prepared by the Joint Chiefs of Staff for mid-level officers — Captains, Majors, Lt. Commanders and such — that had just been completed two weeks ago. The game has the rather prosaic but highly descriptive title *Joint Force Employment (JFE),* but it is anything but prosaic. Its purpose is to ensure that officers from each of the military Services have the opportunity to prepare themselves for "Joint Task Force" operations, which is the integration of military personnel from different services — Army, Navy, Air Force and Marines — into a cohesive interoperable military

organization. The Joint Staff has established "Joint Doctrine," ("doctrine" is the military's term for "the way it should be done") a set of standard guidelines and rules of engagement associates with specific joint operational tasks and functions. *JFE* is, essentially "how to" field training for these officers. According to its official description, it is designed exclusively for today's U.S. Military to convey the concept that "Joint Warfare is Team Warfare" and to enhance knowledge of Joint Doctrine within the US Military. [5]

How much of a real game is *JFE?* Well, for starters it comes in a game-sized shrink-wrapped box printed with fancy graphics and screen shots, looking for the entire world like it should sit on the store shelf right next to *Quake III*, *Age of Empires II*, or *EverQuest*. Even the (real) official Joint Chiefs of Staff logo on the front of box looks — to those of us unfamiliar with it — like an artist's conception right from a commercial game. In fact the *only* thing on the box that gives away that this *isn't* a commercial game are the words "This Product is the property of the United States Government," in the lower right hand corner.

So right from the beginning, rather than *hide* the fact that is a game behind the corporate-speak of "training challenge" or "competition," the military instead *flaunts* the product's "gameness." Just listen to the box copy:

- *Select from computer assisted walk through mode or player controlled mode to create and control large combinations of forces and compete against state of the art computer artificial intelligence (AI).*
- *Adopt the role of Joint Force Commander and tackle ten realistic scenarios to hone your knowledge of doctrine. Adjust friendly and enemy forces in four selectable scenarios to test varying military possibilities.*
- *Spectacular photo-realistic terrain maps that range from the frigid arctic to the vast desert.*
- *3D military units pulled directly from the U.S. Military arsenal.*
- *Dazzling high-resolution and high-detailed graphics.*
- *Dynamic 3D battle effects including flying debris and smoking buildings.*

So *JFE* definitely *looks* like a game. But, much more importantly, JFE also *feels* and *plays* like a game. In fact, it's two games. The first is a pretty traditional quiz game played after a fairly CBTish, "tell-test" intro to Joint Force Doctrine, but the quiz is spiced up with "Jack-like" graphics and sounds. It's the second game, however, that's the "real" game, the meat of the program. That game is a heart-pounding war simulation in which you set your forces rolling and shooting, take out bridges and enemy planes, have air cover flying overhead (if you request it), all in the same dynamic 21/2 D top

down view as up-to-the-minute games like *Warcraft II* and *Command and Conquer*, *Tiberian Sun.* In fact the sub-contractors of the *JFE* game, Semi-Logic Entertainments, are the makers of the games *Real War, Stunt Track Driver* and *Legacy of Kain: Blood Omen*. We're talking state-of-the-art gaming here — the U.S. Military trains is training the staff of the commanders-in-chief (CINCs) with a high-end videogame version of Digital Game-Based Learning. This kind of gaming technology fills a particular niche — training the top of the war fighting command structure. Although the number of personnel in a Joint Task Force (JTF)'s staff is relatively limited, the ability to rapidly integrate military personnel into JTFs and prepare for unanticipated missions "on the fly" justifies the use of online digital games. [6]

A Bit of Military History

The relationship between computer games and the U.S. Military is a relatively long and complex one. The flight simulator, which some think of as coming from the military, was originally designed by Edwin Link in 1930 as an entertainment device. His "Blue Box" was sold to amusement parks until 1934, when Link, a pilot himself, met with the Army Air Corps to sell the Corps on the concept of pilot training with his device. [7] But eventually, as the military devoted more and more money to research, things began to go the other way. By the 80s and early 90s the military had billions of dollars that they spent a year on research and on training, creating very complex, sophisticated types of simulations. All the way up through the early 90s the military was the technology leader, inventor, and financier, and the games companies were the beneficiaries. To a surprising extent the technology in today's commercial games was invented and created in these military-sponsored projects, paid for by DARPA (Defense Advanced Research and Production Agency), STRICOM, The Army's Simulation Training and Instrumentation Command, and others. The entertainment industry now rests on a technological foundation laid by large amounts of government-funded research and infrastructure, including advanced computing systems, computer graphics, and the Internet. In the area of computer graphics, for example, early DOD funding resulted in development of the geometry engine, about 1979. This technology has since been incorporated into a number of game devices, such as the new Nintendo 64 machine. Similarly, early advances in networking in the late 1950s and 1960s laid the groundwork for the ARPANET, which grew into today's Internet and has become the foundation of today's growing networked games industry. In the 70's they developed aircraft, tank and submarine simulators and in the mid 80's SIMNET pods, networked tank simulators that trained the troops up though and including the Gulf War. They have invested more than $1 billion in JSIM, their current high-end simulation technology. The military-sponsored and funded display, simulation and networking technologies in these projects have made their way into almost *all* commercial computer and games, and of course, into military sim games such as *Apache* and *Harpoon.* By the time of the Gulf War, commercial computer games were so close to military reality that — as J.C. Herz wryly points out in her wonderful computer games history *Joystick Nation* — General Schwartzkopf felt the need to explicitly state in a war briefing that "This is not a computer game." [8]

But towards the end of the decade, as the military's budget got crunched, and as cheaper, smaller, more powerful computing power became available commercially, the tide began to turn again. Today, the computer games industry has eclipsed the Department of Defense in terms of what it can do and how fast it can do it, and industry is again leading the technology. Today's military borrows or buys its game technology from the best commercial games. In fact, today's commercial military games have gotten so sophisticated, — having used a battalion of ex-majors, colonels and generals to create super-realistic versions of everything from submarine to tank to the latest fighter and attack helicopter simulations — that they are now being used for training *inside* the military. (This actually began around 1978, when Atari adapted it's *Battlezone* game for ARPA, DARPA's predecessor.) Today the Air National Guard is working with Spectrum HoloByte Inc. to modify the *Falcon 4.0* flight simulator game for military training to compensate for decreased flight training time. [9] The Navy and the Airforce are is negotiating with the makers of consumer flight simulation game*s* to create military versions. The U.S. Marine Corps continuously evaluates commercial war games software for use in training, and the Marine Corps commandant has authorized commanders to permit certain games — including (in 1996) *Harpoon2*, *Tigers on the Prowl*, *Operation Crusader*, *Patriot*, and *DOOM* — to be loaded onto government computers and to allow Marines to play them during duty hours. [10]

And it's not just *equipment* simulators. Other kinds of commercial games and interactive movies, created by companies that put consumer games out on the shelves, are being adapted for military team training, antiterrorism and weapons of mass destruction training, and other projects too secret for them to tell me about (since I didn't want them to have to kill me). Today, when the military has an idea for a training game like *Joint Force Employment,* it farms it out to commercial game houses such as Semi-logic, OCI, Visual Purple, and others rather than building it in-house.

All this, and, yes, the military uses *Jeopardy* for training as well! [11]

Why has the military embraced Digital Game-Based Learning so completely? The first reason, says Don Johnson [12], is cost. "We did it because the other forms of training are so expensive. Even virtual simulation can cost millions to build and millions to and maintain. This doesn't cost you anything to operate once you've built it."

The second reason is motivation. Johnson's group is part of the office of the Secretary of Defense for Personnel and for Readiness, whose job it is to worry about things like recruiting and retention, quality of life, and quality of education and training. They are very mindful that the people that they're trying to bring into the military — the 18 year olds — are probably the first generation that grew up with computers, who "get bored real easy" with traditional classroom instruction. They keep this in mind when designing all their recruiting strategies and training programs, as do the military Services, who turn the young people into soldiers, sailors airmen and marines. And so the Military is beginning to use the web and developing games as a way of recruiting and retaining kids. "I do think the point about being motivational is really a very, very relevant one," says Johnson.

In addition to cost and motivation, add relevance**.** Because modern warfare increasingly takes place on airplane, tank or submarine computer screens without the operator ever seeing the enemy except as a symbol or avatar, simulations can be surprisingly close to the real thing. In addition, since war is a highly competitive situation, with rules (or at least constraints), goals, winners and losers, competitive games are a great way to train. In the words of one former officer: "You play these games as a kid, you grow up understanding the risks and rewards of making decisions in real life." [13] Chess has grown up. War gaming has become a business term.

Kinds of Military Training

Everything short of war is simulation.
-military trainers

The military divides its combat simulation training (as opposed to skills training) into three categories: live, virtual and constructive.

Live training is just that, but over a big range from very large exercises with 5-10,000 people going to Korea or Hawaii or other places to simulate landings or battles, to just a dozen guys in a room, being fed information from the outside to test communications and decision making capabilities in field conditions.

Virtual training includes the SIMNET (simulation network) pods and other simulators. Since 1997 all equipment simulators have been designed — by decree — according to a High Level Architecture (HLA) that lets them talk to each other and work as a team. Virtual training can happen at the individual level, unit level, collective service level, JTF level, or even the coalition level. At the lowest organization levels, today's fledgling pilots, submarine crews and tank drivers climb into SIMNET (simulated network) pods to do everything from learning to drive their vehicle to reenacting entire virtual battles, such as those from the Gulf War. The modern version of SIMNET is JSIMS, which involves literally thousands of pilots, tank commanders, ships, submarines and various levels of officers linked by T1 and T3 lines all playing out the war "at one foot levels of granularity."

At the mid-level of virtual training are the Joint War Fighting Centers where they bring in a unit of commanders and sub commanders and their enlisted support. They play against real ex military guys known as OPFOR (opposing forces). The military units are shown on computer screens in the same symbolic shorthand that the commanders draw on their battle maps. The commanders are "blind" with the communications from the field are as close to the reality as possible. The idea again is to see how the communications really flow and what the problems are.

And at the highest level of virtual training (in terms of command structure, not number of people) are Joint Coalition simulations. For example as a part of NATO's 50th

anniversary celebrations a virtual joint war training simulation was set up linking Washington to the Netherlands to Sweden to England, with each of the "component commanders" — air land and sea — based in a different country. They had to confront issues of time difference, languages, etc. They used a non-combat scenario in that instance: Two countries were battling each other with the conflict threatening to spill over into a third, and the mission was to evacuate a city in the third country, so there wasn't actual combat in the sim. "The reason to do that", says Johnson, "is that some of our "Partners for Peace" allies are not really interested in participating directly in war fighting as part of NATO, but they still need to be able to synchronize their military operations with oter contries around the globe. A significant first step is the development of interoperable simulations and learning environments."

Constructive games are the strategic war games that used to be played on sand tables. Table-top war games for officers go back to the Romans and probably before, with the formalization of it dating from the training of the Prussian Army in the nineteenth century. Now a lot of this has been rolled on to the computer.

JFE is a new hybrid between the virtual and constructive, first tried because the other things are so expensive. It involves decision making, critical thinking, and some level of performance. "In terms of motivation, in terms of getting them to spend time and becoming deeply absorbed in it, and in terms of the competition, it's really amazing how effective this is," says Johnson

Let us now leave the Joint Staff for a minute (we will come back) and look at some Digital Game-Based Learning in the individual services.

The Army

The Army has a variety of Digital Game-Based Learning projects in use and under construction.

One of the Army's (and all the services') biggest needs is to quickly take individuals and mold them into well-functioning teams. How can they be sure people will work together as a team when a crisis occurs? The simulation game *Saving Sergeant Pabletti* (from Will Interactive) is used with over 80,000 soldiers each year for training on some of these team skills from a values perspective. Following basic training, drill sergeants use the interactive video game with large groups of trainees, sometimes up to 300, typically with one or two soldiers designated as the "mouth."

The game got its start when the former chief of staff of the Army, General Reimer saw products that Will had done for kids. According to Sharon Sloane, Will's president, "He called us to the Pentagon and said 'could you build me something on prevention of sexual harassment, army values, equal opportunity, cross cultural communication?' The Army contracted directly with Will to create a customized program, at a cost of $600,000 for the application and accompanying instructor guide. Sloane says the Army is getting

"much better results" from the students because they're engaged and having fun, and since the one program covered so many topics the Army was able to get 15 hours of training down to 4. [14]

STRICOM, the Army's Strategy, Training and Instrumentation Command, is sponsoring several interesting Digital Game-Based Learning projects, including a *Taskforce 2010* PC game for brigade and battalion staff wargaming over the web, a *Spearhead II* tank game, and, like the Navy and Air Force, modification of Microsoft's *Flight Simulator* for Army Aviation. [15]

At the University of Southern California's Institute for Creative Technology, a STRICOM-sponsored project involves bringing in creative artists from Hollywood's special effects studios to work with scientists and Army researchers to create huge "Holodeck"-like environments for mission rehearsal. The idea is to give Army personnel going off to a new part of the world a realistic preview of the environment they can expect, including 360 degree visuals, sounds, language, etc. To do this (and other projects) the institute will receive $45 million in funding over five years. [16]

Recruiting is also a key need for the Army. Two Digital Game-Based Learning projects related to Army recruiting are currently under development by a group led by Professor Michael Zyda, who heads head the Naval Postgraduate College's Modeling, Virtual Environments and Simulation (MOVES) Academic Group. These projects are sponsored by the Assistant Secretary of the Army, Manpower & Reserve Affairs. [17]

MOVES is developing two Army games. The first is a networked, multiplayer realistic "Action Game," using a first person 3D engine, similar to the consumer games *Counter-Strike*, *Delta Force* and *Rainbow Six*. This game is designed to teach and evaluate teamwork and leadership. The focus for the Action Game is on problem solving in an often uncertain, confusing, and chaotic environment. The game will be detailed and at "a level of production quality competitive with commercially available games," according to Zyda's proposal.

MOVES is also developing a "Career Game," whose design goal is to help players visualize possible futures and see the connection between their new skills and later lifestyles. Players guide their character through a simulated Army career, where each education or job experience has the potential to add new capabilities. Their goal is to see how far their characters can advance. The Career Game supports large-scale, multi-player interaction, so that players can take their characters through the simulation together, chatting to each other as they go along.

The eventually intention is to link the two games together. Zyda's goal is "not just to produce videogames for the Army, but to connect the new power of the Internet and videogames with the Army's mission." Good thing, because the cost of these games is not trivial: Development costs are about $700,000 to $800,000 per year for each games. In addition, operations costs for analysis are about $200K/year, maintenance of the web site $200K/year, $500,000 is needed for the 50 servers required to support 150,000

players per day (plus room, high speed connections and maintenance.) Other capital costs, including game engine software licenses at $200K, digital video editing hardware upgrades $100K, and miscellaneous hardware/software for development, come to around $500K/year. And that's just the start. Longer-term costs include $2.1 million per year for years 2 to 4 and possibly beyond. That's what doing consumer-level games costs these days.

What does the Army get for its money? Attractiveness to its recruits on the one hand, and lots of data on the other.

In terms of attractiveness, Zyda's proposal explains that "games hold their audience because they are attractive on the outside (what the player sees and hears while playing) and gripping on the inside (what the player thinks and feels while playing). Sound, music, image, and animation all play their part in satisfying the ears and eyes. Inside a computer game identifiable character and dramatic story both play key roles. In addition, because one PLAYS the computer game, a smooth, uninterrupted sequence (or loop) of actions and decisions must be present. When a game works well, the player may execute this inner loop for hundreds of cycles. If it is smooth enough, the effect is compelling."

In terms of data, both the Action Game and Career Game are "instrumented" to provide an understanding of the players' interests and aptitude, the latter through a link to their AFQT— Armed Forces Qualifying Test — score. Players can link to a variety of career, job, and school information from inside the Career Game. What they choose, how long they spend on the information, and downloads or printouts is noted, summarized and output. Both games collect information about the player's approach to problem solving and dealing with frustration. The Career game collects AFQT (Armed Forces Qualifying Test) information from a player, and correlates it with other standardized tests such as the Armed Services Vocational Aptitude Battery (ASVAB).

While the Career Game provides an indicator of aptitude, the Action Game, says Zyda, provides an indication of leadership potential. He plans to instrument the Action Game to understand the player's ability for team focus. By combining the information from both games, he expects to get a "complete picture" of the potential recruit.

The Navy

Like all the branches, the U.S. Navy simulates as much as it can. There are high-fidelity simulations of everything from landing on an aircraft carrier to putting out fires on a submarine. One Navy project, the Submarine Skills-training Network (SubSkillsNet) puts simulations onto laptops which can be used on-board the subs. SubSkillsNet includes simulations of a surfaced bridge view, radar, sonar displays, fire control functions, and a periscope, all linkable together, so they can train whole teams as well as individuals, and change the training scenarios on the fly.

While these simulations have the necessary degree of fidelity, one issue the Navy experiences is that with this type of instructor-less learning the students have to take the

initiative to start and persist until they have obtained the necessary level of knowledge and skill. So increasing motivation becomes a key goal.

"What you want to do is motivate people to spend more time on the training voluntarily," says Rosemary Garris, of the Naval Air Warfare Center Training Systems Division. [18] Using any kind of training product on-board a submarine is largely based on the initiative of the individual student, so you have to entice them. "You're not going to do it by telling them to read the technical publications." Says Garris, "and a lot of our CBT is very, very dry."

The more Garris and the group of psychologists, computer scientists and engineers in the Science and Technology Division thought about who these learners actually were — 19-year-old American males, not well known for lightness of touch or finesse, according to CDR Adrian McElwee, director of the Navy's Submarine Onboard Training System (SOBT) at the Naval Submarine base in New London CT — the more they began to think seriously about using games for motivation — as many of their users had already suggested. "We wanted to hook submariners. They're all young guys, and they're jazzed by *Quake* and a variety of other games," says Garris. Not rushing in lightly, the Submarine Team led by psychologist Dr Robert Ahlers began a three-year project on training games that is just ending in 2000. "We did a thorough literature review of the educational and psychological literature on games to find the defining characteristics of games and to find out where everyone who has done research in this are was coming from and where they ended up," Garris says.

The team decided, based on their research, to turn one of their own simulations into a game and evaluate its training effectiveness. The task they chose was Periscope Observation for Surface Contact Management. What submariners are supposed to do after identifying a contact is call its angle on the bow — which is how much it's aiming at or away from your ship — and also count divisions, which are tick marks in the reticle of the periscope that help determine range. Calling the angle is one of the most difficult periscope skills. In the standard simulation trainees looked, counted, entered estimates of angle and divisions, got corrective feedback, and looked, counted and entered again. Not too interesting. What was missing in terms of the engagement that would get this stuff learned quickly?

Ask any gamer: ***If the target gets too close, you want to blow it out of the water!***

And so, using what they had learned about game characteristics, Garris' group built the game they call *Bottom Gun*. As in the conventional trainer the player makes estimates of angle and counts the divisions. What makes the game different and fun is that any ship determined to be a threat to ownership safety — defined as any contact that will have a closest point of approach within 4,000 yards — can be destroyed by firing a missile at it. The missile's firing solution is determined by the angle and division calls the trainee made, so that a hit is dependent upon the player's accuracy. "It's totally unrealistic," says Garris. "In real life — or with a conventional simulation — you don't shoot collision threats out of the water, you don't get a score, and you don't get credit for maintaining

weapons stores until the end of the game. There is a lot of fantasy and drama built in that aren't in the conventional trainer."

Why? Years of videogames, which quite likely included commercial sub simulations, have trained these 19-year-olds to expect this kind of real-time, exciting action and feedback. With the game there's a *reason* to know how to tell the range — if the enemy comes too close you can cream the sucker! And you can't fall asleep either. Let them get too close and they start shooting missiles at you!

"Hey, I can do this," say the trainees. And scores go way up, training time way down. Or that's what the Navy expects, anyway. They are collecting pilot data at a local university where they're going to be running up to 120 subjects to do this side-by-side comparison. And because they designed and developed both sets of software it is a very clean comparison—the graphics are exactly the same, the simulation running the applications is exactly the same— between conventional and game-oriented training approaches. Data from the first 16 subjects indicates a desirable learning curve. If the rest of the data does not arrive before publication stay tuned for the second printing. But where would you like to place your bet?

Who designs and builds these games for the Navy? Why, kids from the Games Generations — college students who are gamers themselves and contemporaries of the trainees. Garris's group is located near the University of Central Florida, and they employed most of the programmers on the University's programming team. They're basically college students who are big time game players. They also participate a lot in the design. The initial design of *Bottom Gun* we started out with a radar game, "just seemed boring" to Garris So she went to the kids and I said "What do you think would be more fun?" They roughed out something together that was very consistent with the guidance provided by the academic literature. Garris feels it's very important to include game players on the design team to make sure the 'fun' element doesn't get left out.

This is the future in training design — trainee contemporaries, redesigning the old training in their new style, with experienced guidance. Creation by players is the way it has always worked in the games world. It's the way it will have to work to create effective learning for the Games Generations.

Garris and Ahlers' three-year training game study includes not only a review of the literature, but also an exploration of game-playing motivation. They are evaluating the value of Victor Vroom's V.I.E. (Valence, Instrumentality, Expectancy) Theory [19] in helping understand why these games are so popular. Expectancy Theory deals with how much control over an activity or its outcome a person feels is possible, how effective they believe they would be in that activity, and the degree that they find the outcome of the activity attractive.. "If we can determine what people find so attractive about playing games, we hope we can create training products that meet these same goals while imparting useful knowledge and skills," says Garris.

The Submarine Team is pleased enough with their initial results to begin a new game, based on a virtual walkthrough of a submarine, designed to speed up the transition of

submariners from training school to functioning on-board. "I know a walkthrough doesn't sound much like a game," says Garris, "but we have lots of exciting game-like things in mind." " People are moving faster and faster towards games," she says.

Another Navy-based Digital Game-Based Learning initiative is the Micro-simulator Systems for Immersive Learning Environments project, known as MiSSILE. The goal of the MiSSILE project is to identify consumer PC games and technologies that the Navy can use directly in its training in order to cut costs. The project has determined that while consumer games cannot totally replace higher fidelity simulators, they can support "task shedding" off those higher cost assets, particularly in the early stages of learning. One of the most interesting observations of the project is that "Student Naval Aviators will continue to use PC flight simulators whether or not we endorse, use, or provide them as part of the training tool kit." Wake up and smell the coffee, guys!

An older but interesting Navy-based use of Digital Game-Based Learning came in 1991, when the Chief of Navy Technical Training asked Dr. Henry Halff, a research psychologist, to develop a computer game to teach avionics technicians about basic electricity and electronics. [21] "Two well-known limitations of conventional training and education are lack of opportunities to practice the skills being taught and failure to sustain motivation over the long periods needed to achieve competence in the target skills," says Dr. Halff. "Adventure gaming addresses both of these problems."

Because of their challenging nature, structured concepts, need for quantitative problem solving and qualitative reasoning, technical and scientific subjects such as electronics lend themselves well to Digital Game-Based Learning, according to Halff. "The fantasy aspects of adventure games also offer unique opportunities for instruction," he adds.

The game Halff's team created was called *Electro Adventure*. The scenario is that the Electro, a ship from the future (this is the Navy, remember) has been transported through a mishap to the present day, and must be repaired by the player. The player has to discover technical and safety tricks, combine materials to create things and solve technical problems in each of the ship's compartments. The program combines some adventure game format with some traditional CBT elements and uses what were, at the time, high-end game graphics. Like *Bottom Gun*, Electro Adventure was tested by the Navy against its other learning systems. (See Chapter 14).

The Air Force

According to a number of sources, consumer flight sims have become a *de facto* part of Air Force flight training. "It's almost like that's the first phase of training — you come here fully trained up on flight simulator and we'll throw you into an air force simulator and see how you handle it," says one.

The Air Force, for budget reasons, is being forced to cut back on the number live training sorties pilots can fly by up to 25 percent. [22] According to Major Peter Bonanni [23] of the Virginia Air National Guard, pilots are most proficient when they are first deployed, but as the deployment wears on with no additional training, pilot proficiency slips. While

most high fidelity simulators in use today are not deployable to the field., the most important (and perishable) skills, Bonnini thinks, can be honed by very-low-cost simulators. He cites the computer game *Falcon 4.0* is an example of a commercial product that is shattering the fidelity threshold and providing a model for very-low-cost simulation. Key components of *Falcon 4.0* that allow this type of breakthrough include "SIMNET-like" networking protocols that create a large man-in-the-loop environment. They plan to enhance this capability with commercial head-mounted displays and voice recognition systems.

In a different area — target identification — consultant David Twitchell and Instructional Design Professor David Merrill of Utah State University created a quick recognition game, called *JVID and Finflash* (VI is visual identification and "finflash" is the markings on an aircraft's tail) for the Air Force after pilots accidentally shot down two "friendly" Army's Blackhawk helicopters over Iraq in April 1994. [24] The game, which is a kind of "reflex game" discussed in Chapter 6, has three levels. In Level 1, the player starts off seeing the plane on the runway from above, not moving, and does basic WEFT (wing engine, fuselage, tail) identification. In Level 2 you see the plane from 200 yards in a single view. In Level 3 you are in the cockpit, the plane is coming at you, and you have only 3 or 4 seconds to identify it, just like in real life. Players can choose from many backgrounds, such as sunny sky, cloudy sky, jungle or desert, that may affect identification.(Before the game they used photos, and often remembered the clouds in the pictures rather than the plane markings.) Names and scores are posted, and like with any good videogame, the pilots come back to improve their scores. One of Twitchell and Merlin's objectives in the game was to push pilots to the point where it was *impossible* to identify the aircraft, and to get them to recognize and admit that sometimes it *couldn't* be done — an admission that top gun "jet jockeys" have a hard time making.

The Marines

In addition to allowing its officers and men to play certain military-related commercial computer games on base computers [25], the Marines have also been busy creating some training games of their own. Using a version of the commercial game *Doom* adapted with the help of Lt. Scott Barnett, Marine fire teams have been training at computer labs in Virginia, Georgia and North Carolina learning battlefield tactics and decision-making. [26] Interestingly the skills Barnett was attempting to teach with this action shoot-em-up were not shooting and killing, but rather teamwork, communication and concepts of command and control. What he certainly got was engagement. "It's funny, because at the end of the day I had to kick my Marines out of there and send them home," he says. "The Marines know they're learning, but they're also having fun. I think that's critically important to get them to want to learn."

Marine Doom is played as a networked game. Four member "fire teams" are given four separate computers in the same room. Their goal is to coordinate their movements to eliminate an enemy bunker. "In the lab, we crank the sound up just to add to the confusion and the chaos. Each Marine can shout to his comrades, the fire team leader

shouts commands and they advance on the enemy using what they know about strategy and tactics," says Barnett.

Doom's sequel *Quake*, can network up to 16 players, which can accommodate an entire Marine squad. "I think in the future we're going to see multi-player gaming on a grand scale," Barnett says. "We'll see squads going on squads in a on-line environment." MaK Technologies, a consumer game developer, has already designed a 16-player Marine squad simulator, called *Battle Site Zero*.

The National Guard and Reserves

According to Lt. General Paul Glazer [27], the National Guard uses games to do constructive level (war-gaming) training, leadership training, and battle training. There is a large National Guard "Battle Lab" at Fort Leavenworth Kansas, and smaller labs in other places as well. One game General Glazer describes has soldiers engaging computer-generated enemies with air-powered M16's and mortars. Like the games in arcades the soldiers see the immediate results of their actions — the enemy goes down or he doesn't. But unlike the consumer games, the Military ones carefully track where each bullet goes, so soldiers can learn through replays that the reason they missed, for example was not "leading" a moving target.

When ordering a survival training CD from IBM Learning, the Army Reserves specifically requested that Digital Game-Based Learning be included as part of the design. They wanted an adventure game that trainees could play to dramatically illustrate the value of bringing along all the necessary objects for survival as well as the problems one could encounter if something was forgotten. Interestingly, the game that the IBM developers started with as their "model" or paradigm of how this should work was the "Freddi Fish" series of children's adventure games. [28]

Does this mean our pre-schoolers are learning valuable military skills as they play?

Military Training's "Other" Missions— Schools and Standards

Despite the enormity of their primary mission — to train and prepare the military — the folks in the joint staff training office are thinking bigger still. They do this in at least two ways, both of which are relevant to Digital Game-Based Learning. The first is to extend what they do to other settings outside the military. One instance of this is what they refer to as "interagency" training. In an instance of domestic terrorism, or weapons of mass destruction — referred to in the trade by the much more pleasant-sounding acronym WMD — many groups will have to be coordinated. "If you think a coalition is hard," says Mark Oehlert [29], "try putting together different units within this own country. If something happens in DC there are 12 different law enforcement agencies that have potential jurisdiction, not to mention the DOD. How can we train the FBI, local fire and police, DOD, National Guard, Army reserve to all operate in the most effective manner when we're facing a crisis?"

It turns out there is a serious lack of common doctrine and procedures regarding the roles and responsibilities across local, state and federal organizations. Johnson would like to see these tasks better defined, and training implemented in an interagency game similar to JFE, which would train members of the various agencies to work as a team. "We are just beginning to understand the power and necessity of digital team training," says Johnson.

The second "other mission," of the military trainers is creating common standards for reuse and interoperability of training technologies, a mission which grew out of the government's need for cost savings. In the past, training platforms would change every few years, e.g. from a one inch tape to a 3/4 inch tape to a half inch tape to interactive video disk to a CD-ROM to a DVD, all of it proprietary. Each time the platform changed the trainers would have to adapt the training content to the new media format. Because of this they could never implement learning technology on as large a scale as they would have liked. In the early 90s, realizing that they weren't able to have one flight simulator talk to another one, they decided to set standards. They created something called DIS (distributed interactive simulation protocol) which morphed into HLA (high level architecture) –common standards that allowed interoperability between simulators for team training and reuse of simulation "objects," such as tanks, ships, planes and projectiles. So they saved quite a bit of money by not constantly rebuilding the same objects and reinventing the wheel.

Once they had solved that problem in the simulation area, they began looking into how such common technology standards might be used across the broader education and training areas. The Quadrennial Defense Review (QDR), led them to conclude that using learning technology on a very large scale could save a billion dollars a year. [30] To be able to use technology without having to reinvent it every five years, they realized they needed a common standard so that content could be built once and reused over and over again. If the same standard cut across the public and private sectors and academia, it would allow the development of shared learning objects which would seriously drive down investment costs. The result was the development of ADL (Advanced Distributed Learning) which provides a framework for a distributed learning environment, allowing distribution of high quality content to any device, anywhere, any time.

A new ADL specification, the Sharable Courseware Object Reference Model (SCORM), extends the common standards to digital games. Developed in conjunction with Microsoft, Oracle, IBM, Macromedia and standards groups it enables games to be played on any kind of platform and to share and reuse objets. As a result, the development of Digital Game-Based Learning will be made "several orders of magnitude more efficient and effective," says Johnson, who is one of the project's team members. [30]

Linking Entertainment and Defense — The Conference

Military training has a complex organizational structure, with responsibilities divided between the Joint Command and the Services. One thing that the military appears to do

reasonably well compared to industry is to communicate, share its experiences, and create joint approaches and standards among its members. This may be because there are only four "companies," and they are all owned by the same parent. In principle their goals and objectives are roughly the same, and except for any pride of ownership, there is no reason *not* to share.

This does not extend, however, to sharing with industries *outside* the military. The military may have been doing the same things and trying to solve the same problems as many business trainers, but for a host of reasons until relatively recently only a handful of business people — if any — knew about it, despite the considerable work the Military has done and successes it has had.

A similar situation obtained with the entertainment industries. The two groups, military and entertainment, were working on almost exactly the same set of difficult problems — simulation and modeling — but, since the two groups differ widely in their motivations, objectives, and cultures, they were not only not talking to each other, but were often without a clue as to what the other was doing.

In 1996, the U.S. Department of Defense (DOD)'s Defense Modeling and Simulation Office (DMSO) asked the National Research Council to convene a multidisciplinary committee to evaluate the extent to which the entertainment industry and DOD might be able to better leverage each other's capabilities in modeling and simulation technology and to identify potential areas for greater collaboration. A two-day workshop, titled *Modeling and Simulation: Linking Entertainment and Defense* was held in Irvine, California in October 1996 for members of the entertainment and defense industries to discuss research interests in modeling and simulation. The workshop was unique in that it brought together two communities that traditionally shared little information and transferred little technology between them. [31]

At the workshop more than 50 representatives of the entertainment and defense research communities discussed technical challenges, obstacles to successful sharing of technology and joint research, and mechanisms for facilitating greater collaboration**.** Participants came from the film, video game, location-based entertainment, and theme park industries; DOD; defense contractors; and universities. Through presentations on topics such as electronic storytelling, strategy and war gaming, experiential computing and virtual reality, networked simulation, and low-cost simulation hardware, the committee tried to encourage dialogue and stimulate discussion of research areas of interest to both the entertainment and defense industries. Because the workshop represented one of the first formal attempts to bridge the gap between the entertainment and defense communities, the committee also hoped to encourage personal contacts between members of the two communities as a means of facilitating future collaboration.

Eric Haseltine, of Walt Disney Imagineering, remarked at the workshop that "the thing that the entertainment industry can get the most from DOD is just knowing what's been done, so they don't have to reinvent the wheel." [32] This type of military-civilian conference was a really interesting thing to do, and something the training community might well consider. Given the military's experience and predilections, haring

information between the military and corporate trainers might result in a lot more Digital Game-Based Learning in companies!

Conclusion

The real problem for the military, as Danny Hillis [33] observed at the workshop, is not to simulate a tank or airplane, but to train the person's mind so that when they get into a real tank in a battlefield, they do the right thing. This is why military training has relevance to *all* training. But the question is always *how do we do this*? Michael Parmentier [34] is clear that 18-year old recruits expect to be hooked up electronically to the world "because that's the way they do things. If we don't do things that way, they're not going to want to be in our environment."

As Don Johnson says: "We KNOW the technology works. We just want to get on with using it."

In the next section of the book I will show you how to do this. I will illustrate how *you* can introduce — starting tomorrow— Digital Game-Based Learning into *your* organization, no matter what its size, budget, or learning persuasion.

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Notes

1. The Readiness and Training Unit reports to the Deputy Undersecretary of Defense for Readiness, who reports to the Undersecretary of Defense for Personnel and Readiness.
2. The military's training mission includes approximately eight hundred thousand civilian employees and all military dependents
3. Department of Defense, Office of Readiness and Training.
4. Ibid.
5. This is printed on thegame box.
6. Personal interview with Don Johnson and colleagues
7. There is a sign on an airplane simulator invented by Edwin Link in 1930 at the U.S. Air Force Armament Museum in Pensacola, Florida, that states that it was originally designed as an entertainment device. This "Blue Box" was sold to amusement parks

until 1934, when Link, a pilot himself, met with the Army Air Corp to sell the Corp on the concept of pilot training with his device.
8. Herz, op cit., p. 197
9. Major Peter Bonanni, in a position paper at Modeling and Simulation: Linking Entertainment and Defense Conference, 1996
10. Modeling and Simulation: Linking Entertainment and Defense Conference, 1996.
11. LearningWare's *Game Show Pro* is used by several branches.
12. Donald Johnson is a member of the Readiness and Training Unit and a Team Leader of the Advanced Distributed Learning project.
13. Filipczak, op cit.
14. Telephone interview
15. See *www.stricom.army.mil*
16. According to Paul Asplund of the Institute for Creative Technology
17. The full information is on the Web at *www.upsnet.org/~npsnet/ArmyGame.html*
18. *ibid*
19. Telephone Interview.
20. Garris, R.,; Ahlers, R. "A game-based training model: Development, Application and Evaluation. Paper presented at I/ITSEC, November, 2001
21. See Victor H. Vroom *Work and Motivation*, John Wiley & Sons 1964, reprinted by Jossey Bass (Jossey Bass Management Series) 1994
22. See Chapter 6.
23. *www.cnet.navy.mil/microsim/*
24. Described in Henry M. Halff, "Adventure games for Technical Education," Mei Technology Corporation, San Antonio TX, no date.
25. *Modeling and Simulation: Linking Entertainment and Defense* Report, 1996
26. Major Peter Bonanni, in a position paper at Modeling and Simulation: Linking Entertainment and Defense Conference, 1996
27. Telephone interview with Professor Merrill
28. M *Modeling and Simulation: Linking Entertainment and Defense* Report, 1996
29. Filipczak, *op.cit*.
30. Telephone interview
31. Personal communication
32. Telephone Interview. .Mark Oehlert is with the Office of Readiness and Training.
33. The QDR is a once-every-four-year budget review.
34. Personal Interview
35. Modeling and Simulation: Linking Entertainment and Defense Report, 1996.
36. *ibid*
37. *ibid*
38. *ibid*
39. Telephone interview
40. Telephone interview