The Digital Long Tail in Military Simulation Systems

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Abstract

The high power and low cost of computer games has the potential to enable the emergence of a "Long Tail" in military simulation systems. They will allow us to create and deploy hundreds of different training systems, rather than focusing all of our energy and funding on a few systems that represent combat vehicle operations or command and staff activities.

The concept of the Long Tail was introduced by Chris Anderson in his 2004 *Wired* magazine article and expanded in his 2006 book of the same name. Anderson describes how the Internet changed the market forces for delivering information products like music, movies, and software. Once the cost barriers of creating, delivering, stocking, and selling physical products was broken by digital delivery, it became very profitable to sell digital songs that fall far below the "Top 40" hit titles. His research indicates that there is a very robust market for songs all the way down to the 100,000th most popular song – the long tail of the curve of popularity and consumption. Digital storage and delivery makes it profitable to "stock" and sell all of these titles through services like iTunes, Rhapsody, and Napster.

Computer games enable the same transformation in military training systems. The relatively low cost and high quality of commercial game engines and tools can make it possible to create custom simulations that focus on niche operations and do so at significantly lower costs by comparison with traditional training simulation projects. Rather than a simulation project costing $100 million to create a system, game technologies may allow us to create training environments at various scales from $10 million to $10 thousand.

Potentially, the future of games in simulation is the creation of several hundred niche training systems to serve hundreds of military occupational specialties (MOS's), rather than just cost reductions and visual enhancements to traditional simulation training applications.

Introduction

The commercial market for computer entertainment products has financed and driven the creation of a very robust and growing industry in computer games. Commercial demand for these products has been so strong that it has driven the design of computers, CPUs, graphics cards, sound cards, and a number of other devices. The money earned by these game companies and their supporting hardware providers has allowed them to invest in

research in both software and hardware that has moved the entertainment industry to the head of the technology curve. Today, game companies and commercial graphic chip developers lead technology development, a position that was held by the government, military, medical, and heavy industries throughout the 20th century.

Commercial demand has allowed complex software and powerful hardware to be delivered to customers for under $100 dollars. During the 1990's leading technologies in these areas sold for hundreds of thousands of dollars. Coupling the immense power of these products with significantly lower costs has made it possible to deliver games and simulations to more customers than could be reached at 20th century prices. Game technologies have the power to enable the emergence of a long tail in military simulation that is very similar to that which already exists in digital music. Like the introduction of the Xerox copier, the availability of the technology creates its own demand. "The power of the Xerox copier did not lie in its capability to replace carbon paper and other existing copying technologies, but in its ability to perform services beyond the reach of these technologies. The 914 [copier] created a market for convenience copies that had previously not existed" (Hammer & Champy, 1993).

The Long Tail

Chris Anderson's 2004 article in *Wired* magazine introduced the idea of a "long tail" in digital product sales. He describes how the Internet has lowered product delivery and stocking costs so that it is now very profitable to sell hundreds of thousands of unique products rather than just the "Top 50" products found in most retail stores. The idea is most powerfully applied to music, movies, games, and similar digital products.

Traditional products like computers, textiles, and music CD's all result in a physical item that has both fixed and variable costs associated with its creation and delivery to a customer. Fixed costs refer to the land, facilities, machinery, and similar items required to bring a manufacturing capability into existence. These costs present a large barrier to entry for all companies that wish to compete in an industry. This barrier is an impediment to newcomers, but a protection to established firms. It provides some insurance that everyone will not build a competing facility on a whim and try to enter a market. Variable costs are associated with the materials, labor, packaging, shipping, and storage that are associated with each item that is manufactured. For a textile item like a dress shirt, these include the cost of fabric, buttons, and thread (materials); cutters, sewers, and folders (labor); pins, stays, and bags (packaging); semi-truck delivery (shipping); warehouse space, electricity, and HVAC (storage). Companies work hard to find ways to reduce both their fixed and their variable costs. Lower costs allow them to sell at more competitive prices and to generate higher profit margins.

In this digital age, we have discovered that some products are perfect for changing this cost model and the relationship with the customer. A recorded song or movie is primarily a digital product. But recording the product (song, movie, or game) onto a CD-ROM and shipping it to a store for sale turns this digital product into a physical product, with all of the fixed and variable costs associated with that. If it is possible to deliver the digital

product to the consumer without ever turning it into a physical product, that would significantly reduce the variable costs associated with each song, movie, or game.

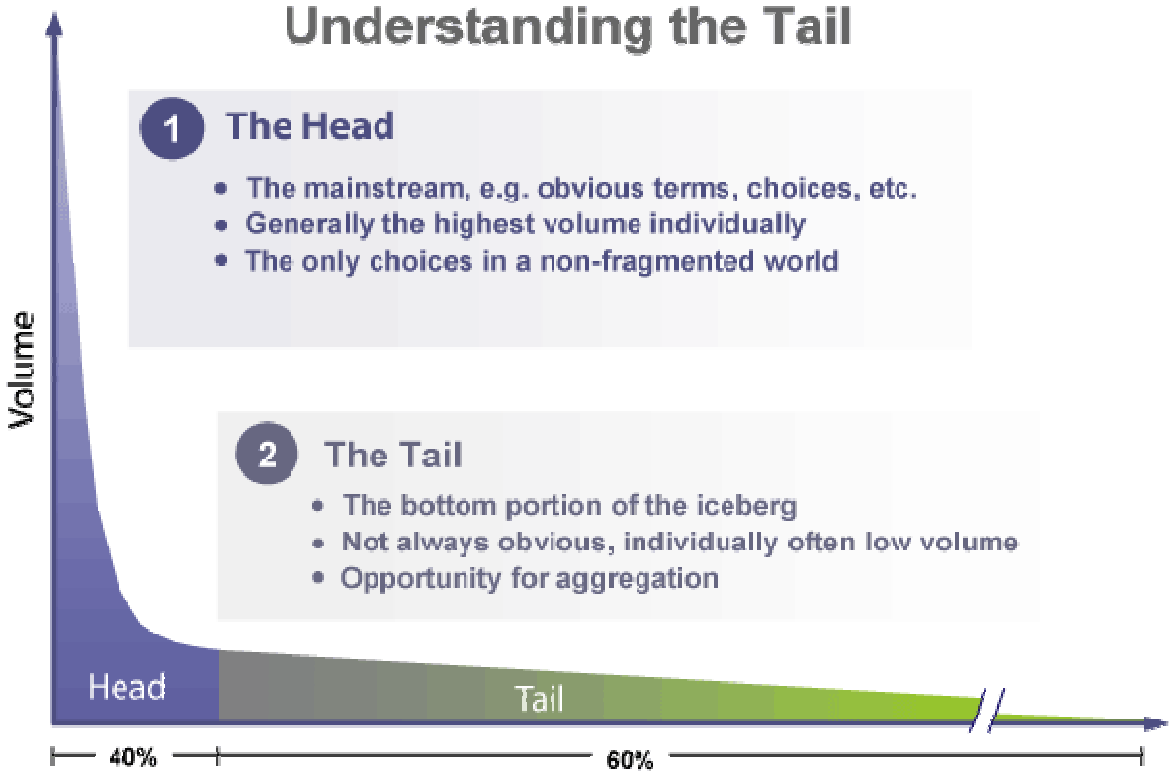

Figure 1. Demand curve for products divided into the "Head" which is delivered by traditional retailers and the "Long Tail" which is unique to digital products.

Companies like iTunes, Rhapsody, and Napster have done this for songs. YouTube, Yahoo! Video, and Lodgenet have done it for movies. Valve Software and Real Media have done it for computer games. When they eliminate the physical costs they become much more competitive than traditional vendors who continue to deliver these products as physical items.

This change means that a physical store is no longer required to stock titles that can be browsed by a human. Instead a digital store can be created which is searchable by product characteristics. This eliminates the need for the physical store to generate sufficient sales to pay for the cost of ordering, stocking, and storing a physical product. Instead, a digital store must only pay for the cost of storing the song on the computer hard drive, entering it into a database, and downloading it to a customer's computer. This cost difference is an order of magnitude (or more) lower for digital than physical products. A digital store has almost no limits on the number of titles that it can afford to make available to a customer.

iTunes and Rhapsody both maintain databases which contain more than 2 million songs. This is far beyond the Top 40 or the Top 1,000 that are available in most physical stores. Digital product companies have also discovered that in any given fiscal quarter, at least one customer purchases every single song or movies loaded in the database. That is

enough to pay for the storage cost of the least popular title and to make a positive contribution to reported quarterly earnings.

These economics tend to imply that physical stores for selling digital products will not be able to compete in the long run with online stores.

Military Simulation Implications

Current military training simulations have the cost model of a physical product. Helicopter flight simulators, for example, include a significant physical hardware suite that must be produced, shipped, stored, and installed at the customer site. Even constructive wargames are usually tied to a unique suite of computer equipment that must be procured and delivered to the customer. These simulations also require that system experts accompany the hardware and software delivery to insure that it is properly installed and configured. For these systems, there does not appear to be an opportunity to take advantage of the Long Tail effect in digital products. These represent the "Short Tailed" limitations of demand for physical products (Figure 2).

Figure 2. Combined hardware/software simulations are a "Short Tailed" product line for military training.

However, the military is increasingly using commercial computer games and the technologies associated with those as a foundation for lighter, desktop training systems. When these simulations can be limited to a software product that will run on a customer's existing computer hardware, they have taken the first step toward being "long tail enabled". If the products can further be designed so that an expert does not have to

accompany them to insure that they are installed properly and taught to the customer, then they have taken the second necessary step toward being a “long tailed” product.

Any training simulation that can be delivered to a customer’s existing computer and used without the help of an expert is a long tail product. Such products do not have to have their roots in computer games. The computer game is one example in which this transformation is becoming possible for military simulations. Games are a commercial business area which has been challenged to eliminate special hardware and expert human support, and which has accomplished this successfully.

Some of the significant advantages of all-digital simulation products are:

- Delivery to customers anywhere on the Internet,
- Accessible far beyond the reach of physical experts,
- Distribution via viral marketing forces,
- Significantly lower variable product costs, and
- Potential to serve much smaller customer niches.

Digital Training Systems for all MOS’s

The focus of military training simulations has historically been on devices that prepare soldiers to perform life-threatening operations. The simulation device is one tool that allows soldiers to develop their expertise with equipment, in teams, or as commanders without risking their own lives or those of others. Historically, these devices have been custom built to teach specific lessons and skills, which has typically led to a combination hardware/software or physical/digital solution. These custom solutions can be very expensive to create, with initial development budgets of over $100 million and per suite prices of $1 million each.

At these prices, the military can only afford to address the most lethal combat operations before it has exhausted the financial and talent resources available in both government and industrial organizations. However, if these simulation systems could be based on commercial desktop software tools rather than custom developed products, it may be possible to create more systems in less time and at lower costs. Game engines and their associated development tools enable this approach to simulations. Therefore, as we are developing digital-only training systems, we should be able to do so for significantly less than is spent on current training simulators (Figure 3).

Figure 3. Commercial game technologies may enable the emergence of a "Long Tailed" product line with a number of lower cost simulations to serve specific training needs.

These tools should allow us to move down the tail of the demand curve for simulation and meet the needs of smaller niches that until now had to use other means for training. If "digital-only" simulations meet the needs of medical, logistics, intelligence, signal, linguist, and public affairs personnel, then we may well be entering a period in which we can afford to address this need.

Breadth of Army MOS'

The U.S. Army identifies its internal job descriptions as Military Occupational Specialties (MOS's). An unofficial list of these compiled on the Wikipedia web site identifies 316 MOS's within the Army. These are grouped into 26 categories and divided into separate lists for enlisted and officer ranks. This list presents one map for determining how many game-based simulations could be built in this long tailed world. However, the list does not identify all of the tasks, operations, or missions that are a unique combination of multiple personnel skills and equipment. It is just one means for understanding the breadth of jobs and schools that exist in one military service. A cursory analysis of this list led to the initial conclusion that game-based simulations could be used for as many as 16 of the 26 major job categories – or about 60%. There are a number of jobs for which simulation is probably not a viable, necessary, or preferred means of training. Some of these are MOS 42R9D (French Horn Player), 79T (Recruiting and Retention Officer), and 92S (Shower/Laundry and Clothing Repair Specialist). However, there are a number of jobs on the list for which a simulation may be very beneficial, but to our knowledge is not yet available. These include MOS 15G (Aircraft Structural

Repairer), 25W (Telecommunications Operations Chief), and 68D (Operating Room Specialist).

Accessibility

As described earlier, the keys to enabling the long tail in military simulation are (1) digital-only products, (2) globally downloadable, and (3) non-expert user friendly. Enabling these requires more than just the creation of a digital training system, it also requires the existence of a global information network that serves high-bandwidth, real-time data to soldiers.

Digital access to the simulation library is a good start, but that must be supported by a repository that is online 24/7, easily searchable, and that can verify the identity of the people accessing the data. The users of the simulations will also need tools that allow them to create or modify scenarios that teach the lessons they are attempting to learn (Figure 4).

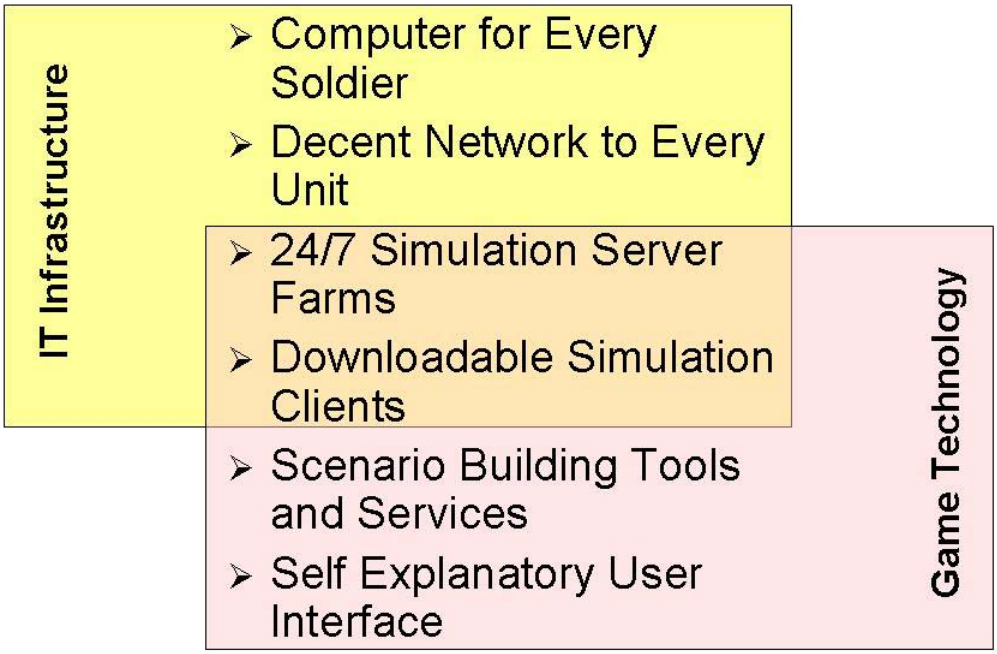

Figure 4. IT Enablers for Broad MOS Training Systems

Key Jobs, Key Trainers

The military has traditionally focused their training on jobs that involve lethal engagements. As game technologies open up the community of soldiers that can have simulation-based training, the metric of lethality will remain one that determines the priority for creating and releasing a new system. An analysis of the fatalities and injuries experienced in the current Iraqi War may aid in identifying the most important tasks for which additional training is needed.

The casualty data compiled at icasualties.org identifies and ranks the causes of death in this war (Table 1). At the top of the list is the Improvised Explosive Device. In fact, this cause is higher than all of the next six causes combined. Until recently there was no IED defense training device and there remains no computer-based training to prepare people to identify, avoid, and defeat IEDs. Desktop, game-based training tools are one means of teaching the skills and procedures for handling these situations.

Another source of fatalities that may be reduced through desktop simulations are non-hostile vehicle and helicopter accidents, which accounted for 323 fatalities between March 2003 and April 2007. There are a number of driving simulators and driving games which could be readily modified to teach specific skills that are leading to accidents in daily operations.

Table 1. Top 11 Causes of death in the Iraq War from March 2003 to April 2007

Cause of Death Detail	Total	Percentage
Hostile - hostile fire - IED attack	**1309**	36.4%
Hostile - hostile fire	**514**	14.3%
Hostile - hostile fire - small arms fire	**274**	7.6%
Non-hostile - vehicle accident	**232**	6.5%
Hostile - hostile fire - car bomb	**102**	2.8%
Hostile - hostile fire - mortar attack	**94**	2.6%
Non-hostile - helicopter crash	**91**	2.5%
Hostile - hostile fire - RPG attack	**82**	2.3%
Hostile - helicopter crash	**80**	2.2%
Hostile - hostile fire - ambush	**60**	1.7%
Hostile - hostile fire - suicide car bomb	**59**	1.6%

Source: icasualties.org

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Conclusion

Computer games and the technologies that they have advanced offer the opportunity to deploy a game-based training simulation to every soldier in the world. They allow us to escape the burden of special hardware devices, centralized training facilities, and the staff of experts required to run existing systems. Though the existing systems will continue to be a central part of the military training regime, games could enable us to extend training beyond these and create a long tail of products that fit into unique niches. In some cases, game-based systems will also offer a lower cost alternative to existing systems. This may become more important when defense budgets diminish or funding is directed away from training systems to support operational equipment and missions.

The long tail of digital products described by Chris Anderson can potentially express itself in the military simulation industry. Desktop game technologies are one of the tools that can make this happen.

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Biography

Dr. Roger Smith is the Chief Scientist and CTO for U.S. Army Simulation, Training and Instrumentation. He is focused on bringing innovative technologies into Army training and testing events. His organization awards over $2 billion dollars in government contracts each year, primarily focused in simulation, training, and gaming technologies. He has published over 100 technical papers on gaming, simulation, and innovation. He has lectured at the University of Central Florida, Full Sail, University of Texas, University of Virginia, Georgia Tech, and Florida Institute of Technology. He serves on the editorial boards of the *ACM Transactions on Modeling and Computer Simulation* and the *IRI Research Technology Management*. Dr. Smith holds degrees in Computer Science (Ph.D.), Statistics (M.S.), Mathematics (B.S.), and Management (MBA and M.S.).

Attachments

The following attachments were removed from this version for brevity.

Attachment 1: U.S. Army Military Occupational Specialties

Attachment 2: Iraq War Casualties: March 2003 to 14 April 2007