



"Tools and Technology that make 3D Simulation a Game"

WHITE PAPER

Promoting Learning by Doing Through Simulations and Games

soVoz, Inc.

37 Station Drive, Suite A
Princeton, NJ 08550
609-799-8544, x11

Contact: Stephen H. Lane, Ph.D.
lane@sovoz.com

March 2005

INTRODUCTION

National guardsmen, Army reservists and United Nations peacekeeping forces are trained at home in a timely manner, using web-based courseware featuring game-like 3D simulations, how to control hostile crowds in a variety of situations, in preparation for a forthcoming deployment in the Middle East...

An emergency rescue worker uses an interactive 3D simulation to learn how to properly secure and evacuate various multi-story buildings in his community assuming they were suspected of being contaminated with Anthrax. He acquires knowledge of the environment by interacting with 3D models of the building, its emergency exit routes, and electrical and HVAC system schematics. Armed with this information, he is able to isolate the biohazard quickly, shut down the ventilation systems and evacuate personnel from the building in a safe and orderly manner...

A pharmaceutical company uses game-like interactive courseware, featuring 3D graphics and animation, to train and educate both physicians and patients on the physiology and pharmacology of a new drug. Given the modular way in which the course content was created, the same 3D assets are also reused in an online sales presentation as well as in the drug's marketing and advertising campaign. The company not only sees an increase in the rate of initial physician prescriptions due to this type of medical training and education, but also an extension in the number of patient prescription refills, due to better understanding by both of the efficacy of the new drug.

A high school student accesses college-level mechanical engineering courses through a game console with Internet access set up in her living room. Using 3D graphics and animation combined with text, pictures, audio and video, the student masters her subject and excels at her courses, leading to a scholarship at a prestigious engineering school...

THE FUTURE OF LEARNING

Advances in the fields of interactive multimedia, computer graphics and animation, cognitive learning theory and artificial intelligence are converging to enable the deployment of highly effective simulation-based learning systems. As a supplement to traditional classroom methods of instructor-led training, simulation-based systems not only can increase learner skills and knowledge retention, but also can reduce the costs of developing and distributing education and training content as well. The amazing power of today's personal computers, both in terms of processing speed and real-time 3D graphics capabilities, coupled with increasing broadband Internet user access, now make it possible to develop high quality, multi-user experiences using off-the-shelf commercial game technology and tools. As a result, next generation learning systems will feature much more interactive forms of instructional content that simultaneously engage and educate the user, promoting learning comprehension, knowledge retention and skill development using techniques such as physical simulation, group collaboration, game-like training scenarios and intelligent tutoring.

ADVANCED DISTRIBUTED LEARNING AND THE IMPORTANCE OF LEARNING BY DOING

Current advanced distributed learning¹ and computer-based training systems allow students to learn at their own pace, anytime and anywhere, using Powerpoint-like courseware. However, the limited functionality of these current systems is inadequate for many types of training applications. Decades of cognitive science research have shown that people perform significantly better in decision making and hands-on training tasks when they can also learn in the context of doing². That is, they develop a deeper, fuller understanding of the concepts presented, they retain knowledge better, and can acquire new skills more readily when the learning process involves performing tasks and solving complex problems in a realistic setting.

The US Department of Defense and other government, corporate and industrial organizations with major training requirements have been aware of the value of learning by doing for some time. Over the years they have used live training exercises and large, distributed, multi-user scenario simulations to not only develop and refine individual skills, but also effectively train large groups of people how to work together in complex situations. Although live training exercises are in some ways the next best thing to being there, they are limited in scope, difficult to replay, expensive and often impractical for many training needs. This leaves computer-based simulation as the only viable alternative.

SIMULATIONS AND GAMES

Computer-Based Simulations. Whether the goal is primary instruction, individual skill development, strategic thinking, competitive tactics or group collaboration, computer-based simulation technology is the key to enabling “learning by doing” capabilities in a wide variety of training and education applications. In addition, the entertainment value and personal challenges that computer-based simulations can provide also encourages repeated usage and helps motivate otherwise uninspired or disinterested learners. A whole generation is currently being raised on this type of human/computer interaction in the form of educational computer games. It is only natural to expect that they will want to continue to learn in this manner as they graduate to institutions of higher learning and receive on the job training in industrial, corporate and government organizations. Currently, there is a great deal of interest in using commercial computer game technology (i.e. 3D graphics, interactive animation, physics, artificial intelligence, etc.), both in government and industry, to develop computer-based simulation capabilities in advanced distributed learning applications.

Simulation-Based Learning Scenarios. Since the sequence of events that unfolds in computer-based simulations is determined by the decisions and actions of the participants, simulation-based learning scenarios can place users in realistic situations where they must think and act in real time. For example, to allow technicians to practice maintenance and

¹ The Advanced Distributed Learning (ADL) initiative was launched by the Office of the Sec't of Defense to promote access to high-quality education and training materials that can be tailored to individual learner needs and made available whenever and wherever they are required. This initiative was designed to accelerate large-scale development of dynamic and cost-effective learning software and to stimulate a vigorous market for these products in order to meet the education and training needs of the military and the nation's workforce in the 21st century.

² Bransford, J.D. Brown, A.L., Cocking, R.R. (Eds). *How People Learn: Brain, Mind, Experience, and School*. Committee on Developments in the Science of Learning, NRC, Washington, D.C. National Academy Press (1999).

repair procedures before servicing complex and expensive pieces of equipment or to train emergency response teams how to respond to various WMD scenarios using operationally-correct strategies, tactics and procedures. Computer-based simulations also allow users to replay and explore different scenarios, and practice scenarios from multiple perspectives. In real life, trying new strategies, such as shutting down an airport after finding a bomb in an unattended piece of luggage could have serious economic or public relations consequences. In simulation-based learning, learners develop a deeper understanding of *why* a procedure works and can practice applying it across multiple scenarios. Users can also practice taking different roles. For example, the airport manager may try playing as a security guard, or a security guard might role play as a first responder. Role playing from different perspectives allows the learner to develop a richer mental model for how a team should operate. Learners come to understand how each part fits together, as well as the specific needs and challenges of each role, which leads to greater performance for the organization as a whole

NEED TO REDUCE COST OF USING GAME TECHNOLOGY IN SIMULATION AND TRAINING

Although commercial computer game technology can be used to develop effective 3D simulations for training applications, it is not easy or cheap to use. For example, the average video game takes almost two years to produce at a cost usually in the range of \$3M to \$6M. The budgets for most computer-based training applications, on the other hand, are typically in the \$50K - \$500K range. As a result, use of commercial game technology to develop simulations for advanced distributed learning and training applications is rather rare³. In order for gaming technology to be used effectively to create a whole new generation of simulation-based training applications, the cost of production has to be dramatically reduced. This high cost of production currently originates from five main sources:

- **Specialized Skill Sets**. The game engines of today require professional artists, animators and programmers with highly specialized skill sets who are familiar with 3D graphics modeling and animation tools, production techniques and programming languages such as C++.
- **Proprietary Game Engines and Production Pipelines**. Commercial game engines are expensive, difficult to use and require sophisticated production pipelines to get art from graphics and animation authoring tools into the game.
- **Production Bottlenecks**. Technical interdependencies between artists, animators, designers and programmers complicate the work effort, often resulting in scheduling delays and inefficient use of human resources.
- **Failure to Reuse Code and Content**. Most games are developed with a specific game engine in mind. As a result, it becomes very difficult to reuse application content and game logic from project to project.
- **Limited Ability to Validate Effectiveness of Design**. It is not unusual for 80% of the total development time to be spent developing technology and 20% developing content. As a result, costly design mistakes are often discovered too late. This can only be avoided if the designer is given the ability to validate his design ideas early and often (i.e. 80% of the time should be spent developing content and 20% developing technology).

³ A few exceptions are: Americas Army (www.americasarmy.com) and Full Spectrum Warrior (www.fullspectrumwarrior.com) which had development costs of \$12M and \$45M, respectively.

THE soVOZ SOLUTION

soVoz has developed advanced 3D simulation technology⁴, known as ProScena™, that significantly reduces the cost and complexity of using commercial computer game technology in the development of simulation, training, education and gaming applications. Based on the ProScena™ technology, soVoz has developed a solution that is:

- **Affordable** - Allows small development teams to benefit from state-of-the-art game technology, tools and know how at a fraction of the price without having to get bogged down with low-level implementation details. This speeds delivery of simulation-based training content by focusing the development team on content creation, as opposed to technology infrastructure, support and development.
- **Accessible** – Manages the complexity of the simulation development process by supporting all team members (i.e. designers, artists, programmers, instructors, etc.) with role-appropriate access and authoring facilities. This eliminates production bottlenecks and allows designers to quickly prototype, test and refine their designs with minimal assistance from artists, animators and programmers.
- **Reusable**. The ProScena™ component-based approach enables simulation content to be designed from the ground up to be reusable. This allows investments made in application content to be reused in different projects within and across organizations.
- **Extensible** – The component-based approach also allows almost every piece of the ProScena™ system to be replaced or modified to suit project needs as technology evolves or requirements change.
- **Interoperable** – ProScena™ simulation content is portable across a variety of popular hardware platforms (i.e. PC, game consoles, handhelds) and software platforms.

As a result, the soVoz solution is extremely relevant to the cost effective and timely development of 3D simulations for a variety of applications such as: homeland security/emergency response team training; technician training - including equipment assembly, maintenance and repair; product demonstrations and visualizations; military and law enforcement operations training and mission rehearsal; personnel training – including management, sales and other role playing simulations; and of course interactive entertainment.

⁴ The ProScena technology has been funded in part through SBIR contracts with the Office of the Secretary of Defense (OSD), the US Army and the Office of Naval Research.