INFANTRY OFFICER BASIC COURSE (IOBC)
RAPID DECISION TRAINER (RDT)

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ABSTRACT

The Department of Defense recently published the roadmap for transforming future military training in the document *Strategic Plan for Transforming DOD Training*. Distributed learning technologies play a key role in the DOD training transformation strategy and support *life-long learning*, a key component of the Army's training transformation strategy. The U.S. Army Training & Doctrine Command (TRADOC) is leveraging distributed learning capabilities as a means to improve training effectiveness, reduce training costs, and improve overall soldier readiness. Research continues in the Army to improve distributed learning technologies as well as its ability to incorporate these technologies in both resident and non-resident training programs.

Newly commissioned infantry second lieutenants are trained at the US Army Infantry Officer Basic Course (IOBC) at Ft. Benning, GA. To successfully complete the course, IOBC students must demonstrate an understanding of individual and small unit infantry skills by participating in live-fire battle drill exercises. Resource constraints limit the number of students who can perform in leadership roles during the live-fire exercises, thus preventing many of the students from fully demonstrating their knowledge and skills. Distributed learning technologies are helping to address this training shortfall. A research effort led by the U.S. Army Research, Development and Engineering Command's Simulation Technology Center is producing a PC-based, web-enabled, rapid decision trainer, enabling all IOBC students to participate as the leader in a "virtual live-fire exercise." The trainer will successfully demonstrated the use of distributed learning technology to enhance live training.

The trainer incorporates web-enabled 3D graphics and audio content built upon open source technologies. Training scenarios are delivered through Extensible Markup Language (XML). A Learning Management System (LMS) will provide instructors with feedback and a summary of student performance. The trainer will use existing government standards such as the High Level Architecture (HLA) and the Sharable Content Object Reference Model (SCORM).

ABOUT THE AUTHORS

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INTRODUCTION

Armed conflicts at the end of the 20th century and recent events in Iraq and Afghanistan have demonstrated conclusively that the armed forces of the United States are the premier warfighting force in the world today. However, new threats created in the dynamic international environment will continue to challenge the US military's dominance in the 21st century. In response to these new and emerging threats, the Department of Defense (DOD) has developed an ambitious strategy to transform the armed forces and insure they have the capabilities to meet these new security challenges. Central to this transformation strategy are DOD's efforts to identify new and innovative ways to educate, train, and improve unit and individual performance. Superior training and knowledge will be critical to continued success on the modern battlefield.

In March 2002, DOD published the ***Strategic Plan for Transforming DOD Training***. The goal of this strategy is to develop a robust, networked, live, virtual, and constructive training and mission rehearsal environment that will enable US military forces to build unparalleled joint military capabilities. DOD training transformation efforts will capitalize on the capabilities and power of modern computing and telecommunication systems and will deliver training opportunities that were impossible just a few years ago.

Advanced Distributed Learning (ADL) technologies are a key and essential component of the DOD Training Transformation Strategy. ADL programs will provide DOD personnel with access to high quality education and training opportunities that can be tailored to meet individual needs and delivered cost effectively, wherever and whenever training is required.

In general, the benefits of ADL learning are recognized as:

- reduced learning time
- increased content retention
- increased student motivation through active involvement in learning activities
- increased safety
- increased access to training opportunities and resources
- increased learner satisfaction
- improved instructional consistency

Each military service has initiated a training transformation strategy based on the overall DOD effort while supporting its specific training requirements. ADL is a key component of the strategy for each service. Within the Army, organizations such as the US Army Training & Doctrine Command (TRADOC), the US Army Research, Development, and Engineering Command (RDECOM), and the Army Research Institute (ARI) are working together to develop the technologies, tools, and procedures that will provide efficient and effective distance learning training capabilities to support the future force.

NEED FOR THE IOBC RAPID DECISION TRAINER (RDT)

The U.S. Army's Infantry School (USAIS) is the US Army TRADOC organization responsible for training infantry officers, non-commissioned officers, and infantry soldiers through resident and non-resident training programs at Ft. Benning, Georgia. USAIS trains newly-commissioned infantry second lieutenants through the Infantry Officer Basic Course (IOBC).

The IOBC is an intense, 16-week, resident training program that prepares new infantry officers for their first assignment as infantry platoon leaders. Each IOBC course includes approximately 200 students.

To successfully complete the course, IOBC students must learn and demonstrate proficiency in the tactics, techniques, and procedures that guide the training and war-fighting of an infantry platoon. This includes an understanding of individual, squad, and platoon-level infantry operations as described in the US Army Training and Evaluation Program (ARTEP) Manual 7-8, ***Infantry Rifle Platoon and Squad.*** Students are required to demonstrate their understanding of basic infantry principles through written examinations and practical exercises, such as participating in both squad and platoon-level live-fire exercises at Ft. Benning. The squad-level live-fire exercise is conducted at the Ware Live-Fire Range and the platoon exercise is conducted at the Griswold Live-Fire Range.

The squad and platoon level live-fire training exercises are divided into three events using a “crawl, walk, run” approach. The first event is a walk-through, “dry-fire” exercise where instructors accompany students over the exercise terrain describing the scenario and actions that should be performed by the unit. The students conduct the second event in “real-time” using blank ammunition while maneuvering at combat speed. The third event mirrors the maneuver of the blank fire but introduces live ammunition to the exercise increasing realism in the training. The introduction of live ammunition in the third event increases the intensity, risk, and stress in the training exercise and produces a highly effective training experience. Feedback is provided to the students by platoon trainers and instructors at the conclusion of each training event.

Ideally, all IOBC students should serve in a key leadership position during a live-fire. The four key leadership positions in an infantry platoon are platoon leader, platoon sergeant, squad leader, and fire team leader. Students assigned to one of these positions face the most challenging decisions thereby providing the students with an excellent opportunity to develop the tactical knowledge and rapid decision-making skills required of an infantry platoon leader. Live-fire exercises also help instructors to evaluate each student’s understanding of key doctrinal principles prior to graduation from the course.

Unfortunately, resource constraints significantly limit the number of students who can perform in a leadership position during the live-fire exercises. Time is the major constraint facing course planners; however, other factors such as limited ammunition and range availability are also constraints affecting this training opportunity. Due to these constraints, only 50% of the students serve in key leadership positions during live-fire exercises, and of those, only two students in each 40-man platoon serve in platoon-level leadership positions (platoon leader and platoon sergeant).

To address this challenge and improve the training for all students, the USAIS and the Commander, 11th Infantry Regiment, began to investigate the use of simulations or PC-based games as an alternative way to provide an effective training environment for all IOBC students. In February 2003, the USAIS requested assistance from the US Army Research, Development, and Engineering Command, Simulation Technology Center (RDECOM STC) in Orlando, FL, to develop a low-cost, PC-based, rapid decision trainer (RDT) to supplement the IOBC live-fire training program.

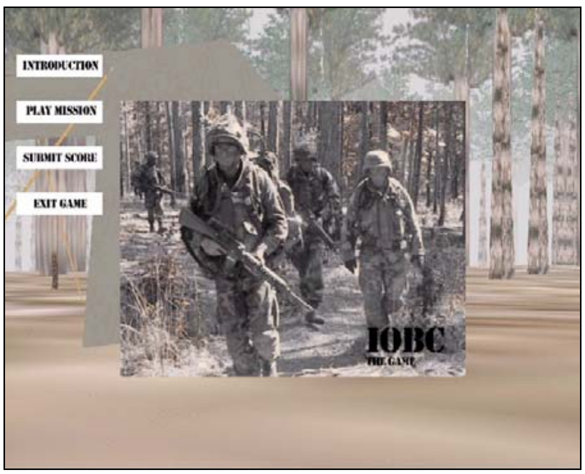
Two primary objectives were established for the RDT initiative. The first was to develop a training simulation or PC-game that would satisfy the training requirement identified by the USAIS. The RDT would provide a challenging, doctrinally correct learning environment to help IOBC students master the skills required to successfully complete a squad or platoon-level live fire exercise.

Secondly, the project would expand the research being conducted by the RDECOM STC in advanced learning environments by developing a trainer that integrates doctrinally accurate courseware, a virtual simulation, an effective After-Action-Review (AAR) capability, and a Learning Management System (LMS). Students could utilize the trainer both in class and during non-duty hours rerunning each scenario multiple times and receiving effective feedback on their performance through the AAR capability. A record of the student’s performance could be maintained by the LMS and reported to both the students and instructors for further evaluation.

The initial prototype was to be developed as a stand-alone PC trainer with future work expanding it to support both single-player and multi-player participation in a web-based environment. The web-based training will be compliant with technical standards established by the Department of Defense Shared Content Object Reference Model (SCORM).

During initial discussions with the USAIS, the Commander, 11th Regiment envisioned that students be issued a copy of the trainer during the IOBC course of instruction and participate as either a squad or platoon leader during the trainer's "virtual live-fire exercises." He requested that the scenarios presented by the trainer closely resemble those conducted during the IOBC live-fire training.

The RDECOM STC will develop the RDT over a seven-month period with Subject Matter Expert (SME) support provided by the USAIS. Funding was provided through the FY01-03 Science and Technology Objective (STO), ***Training Tools for Collaborative Web-based Environments.*** The RDECOM STC will deliver the squad-level trainer to the USAIS in July 2003 and the platoon-level trainer in September 2003.



The purpose of the RDT is not to replace the IOBC live-fire exercises; but will provide an effective, low-cost tool for supplementing the live training. Additional research and development work is planned in FY04 as a number of enhancements to the system have been identified. Additionally, research will also be conducted to evaluate the effectiveness of the trainer on overall student performance.

TECHNICAL APPROACH

There are four basic phases to the process being used to develop the RDT. The first phase included the initial work performed by the system developers and SMEs to define the system requirements and course content. The second phase included development of the PC-based, squad-level simulation. The third phase will extend the PC-based simulation to a web-based, SCORM-compliant application. The fourth phase will include the development of a PC-based, platoon-level exercise.

Defining the Requirement

Clearly defining the system requirements and understanding the customer's expectations at the beginning of the project were critical steps in ensuring the successful development of the trainer. Members of RDECOM STC and the supporting contractors participated in a number of meetings and discussions with USAIS Platoon Trainers and SMEs to review the training objectives and to fully develop the virtual training scenarios. The team observed and videotaped several iterations of both the squad and platoon live-fire exercises. It then prepared detailed scripts for each scenario and forwarded them to the Infantry School SMEs who reviewed them for accuracy. Frequent contact between the software developers and the SMEs throughout the development process ensured that the trainer met the customer's needs and expectations.

Simulation Development

The IOBC simulation application was developed using ***Alloy***, a platform-independent, three-dimensional game engine. The game engine is built upon a foundation of several freely-available, freely-distributable, well-respected software products. The game engine includes an open-source audio library and an open-source graphics project called ***OpenSceneGraph***, a mature, robust, 3D graphics library. The ***Alloy*** game engine supports the following functionalities:

- View, display, and interact with 3D graphics created from the most common graphics tools used in the modeling and simulation community (Tools include ***Multigen OpenFlight*** and ***Discreet 3D Studio Max***. Other formats such as ***Maya*** can be translated for the ***Alloy*** game engine using a graphics conversion utility.)

- Integrated 3D spatialized sound, supporting the most common sound formats including Wav and Midi.

- Integration of video clips in the 3D environment.

- 3D character animation and movement using deformable mesh technology, including full support for motion-capture animation technology

- Simulated weather and environmental effects including rain, hail, snow, fire, smoke, ash, ordnance detonation, and rubble, as well as primitive support for the development of additional undefined effects

- Multiple types of hardware input devices including joysticks, mice, and keyboards

The ***Alloy*** game engine includes a Graphics User Interface (GUI) application that allows an engineer or instructional designer to combine graphical, sound, or other simulation components with a simulation sensor-behavior model. It enables instructional designers to form persistent, scalable, and multi-rolled learning scenarios. This capability facilitates the development of the various team, squad, and platoon leadership learning scenarios created in the trainer. Future scenarios for RDT can be developed by the IOBC and can be easily modified as Army doctrine and IOBC learning objectives evolve.

SCORM Integration

A major objective of this research effort was to expand the squad-level trainer from a PC-based, single player trainer, to a web-enabled, SCORM-compliant environment. The SCORM-conformant content package developed for this part of the effort included a set of instructional modules and files that are loaded into a SCORM-conformant LMS. Once loaded, this package can be accessed by students via the Internet and run on a computer at the Infantry School or a student's personal computer. The content package contains Shareable Content Objects (SCOs), Shareable Content Assets (SCAs) and metadata that provides information for the LMS to run the package. The following types of COs were created for the RDT:

- Teaching SCO – a set of web pages and associated files that presents instructional material to a student.

- Testing SCO – a set of web pages and associated files that implements an evaluation of a student's knowledge. In the case of the RDT, the Testing SCO invokes the simulation.

- Assessment SCO - a set of web pages and associated files that performs the assessment of a student's performance against the defined learning objectives.

API Adapter

SCORM provides a single, defined, JavaScript interface between an LMS and a SCO. Each LMS implements the JavaScript interface to provide the standard interface for SCOs. This interface is normally called the "API Adapter." By definition, all SCOs require JavaScript, and all communication with the LMS is via JavaScript. A major challenge for interfacing a simulation with a SCORM compliant LMS is the JavaScript interface.

SCO/Simulation Architecture

The limitations of the JavaScript language and the browser/web page model make it difficult to interface with applications that execute outside of the browser. Ideally, the most effective solution to this problem would have an optimal combination of several factors. These include the programming language and file size of the application, as well as the requirements for platform support, browser support, and performance. System developers evaluated "Plug-ins," "Java Applets," and "ActiveX Components" as possible methods for interfacing the simulation to JavaScript.

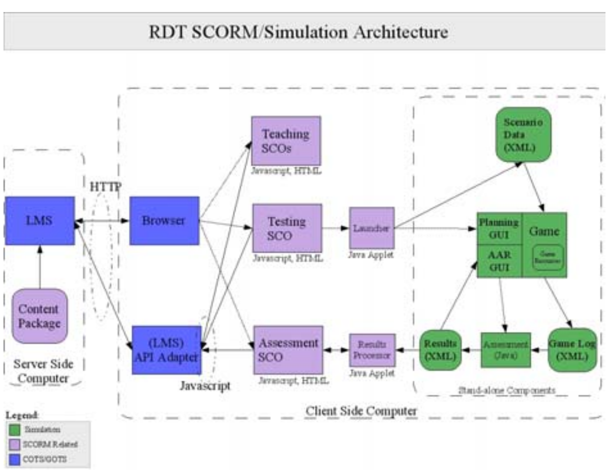
Assessment of Alternatives

"Plug-ins" are platform and browser-specific. Since the students are apt to use a variety of hardware and browsers to utilize the trainer, developing a different version of a plug-in would be potentially needed for each platform or browser combination. The Plug-ins are typically activated by the MIME type of an accessed resource on the server. This requires a configuration of the LMS server to generate the proper MIME type.

ActiveX Controls are software modules that are implemented using Microsoft's ActiveX Framework. Microsoft Windows platforms will support them using Internet Explorer and Netscape Navigator (using a Microsoft ActiveX plug-in). Although Microsoft states that ActiveX controls will run on UNIX, it is only possible using a third-party Windows OS emulator. Default security limits the ability to perform some operations on the client computer. Allowing secure operations involves configuring the client browser/computer and digitally signing the control.

Java Applets are Java software modules launched by the browser. They are platform independent and have been supported by all of the common browsers currently in use. Security issues are similar to ActiveX. However, applets installed on the client computer (as opposed to downloaded by the web page) do not have the security limitations. Allowing secure operations for downloaded applets requires a modification of the Java security policy file.

In order to provide the best platform and browser independence, the software developers chose the Java Applets approach. The following diagram outlining the SCORM Simulation Interface architecture is shown below.



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Delivery Methods

Ensuring the trainer was platform independent and easy to install was a major goal in creating the web-enabled version of the RDT. Initially, the developers assumed that the SCORM-conformant LMS would be used to download the files necessary to execute a SCO directly to the student's computer. Under this method, a student would access both the Testing SCO and the RDT application after they were downloaded and launched on the student's computer. However, the size of the RDT software precluded this approach.

CD-ROM was chosen as the method of delivery due to the size of the application and the difficulty in setting up a network-accessible download site for IOBC students. The USAIS has been able to install a RDT prototype on school computers and the RDT will be issued on CD-ROM to each IOBC student for installation on their individual computers. In order to take advantage of a client installation and avoid the problem of configuring applet security privileges, developers used a CD-ROM as the delivery method.

SCO/Simulation Interface

By defining an XML interface between the simulation and the SCORM components, the developers have allowed for language and execution independence. The simulation can use any programming language as long as it generates the XML data. Execution independence means that the simulation and the SCORM components do not need to run at the same time or even on the same computer. The only requirement is that the XML data be available to the Assessment SCO. An additional benefit is that it simplifies the reuse of the SCORM components with any other simulation.

There are 3 XML files that define the interface between the SCOs and the simulation:

- Scenario Setup – provides the player information, scenario selection, and other configuration parameters to the simulation.
- Game Log – a detailed log of the simulation that is generated by the simulation and used for assessing performance against the learning objectives.
- Assessment Results – a summary of the assessment of learning objectives are recorded in the LMS and are used for After-Action-Review.

Assessment

A critical step in the initial phase of the project was defining the learning objectives for the training. This was also essential in developing the assessment component of the learning environment. SMEs from the Infantry School played a key role in helping to define these learning objectives. Once defined, the challenge from a systems design perspective was to determine how to measure performance against those objectives. The following set of data types was established:

- Time (Events)
- Distance
- Area
- Identity
- Enumerated (type, color, etc.)
- Numeric (quantity, health, etc.)

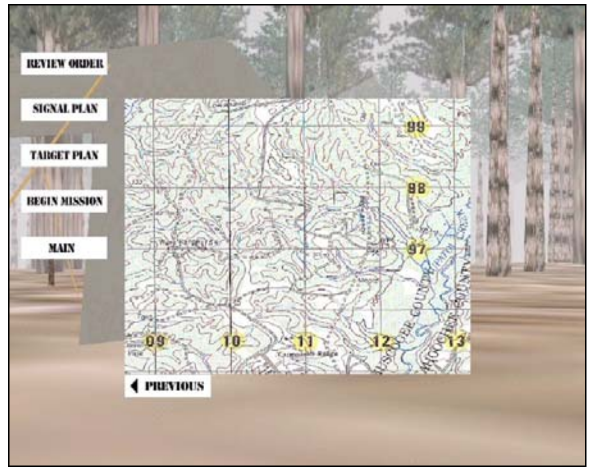
Using these base data types, the developers were able to express the measure of performance in terms of these data types. An assessment engine was developed to interpret the criteria and apply it to a game log. The results are written to the Assessment Results XML file, the Assessment SCO, and the LMS to support AAR functions.

Course Structure

The Teaching SCOs are organized around each of the learning objectives. Each objective is based on Army doctrine and is described using official Army field manuals as references. Publicly available copies of the manuals are provided on the CD-ROM for fast, easy access.

FUTURE RDT DEVELOPMENT EFFORTS

The current version of the RDT includes two basic scenarios that replicate the squad and platoon live-fire exercises at Ft. Benning's Ware and Griswold Firing Ranges. The two scenarios have met the initial USAIS training objectives; however, modifying the trainer and expanding its capabilities can enhance the quality and effectiveness of the RDT.



Additional research is planned in FY04 to incorporate changes in the current virtual environment. Examples of the changes being contemplated include adding natural or man-made obstacles in the terrain database (e.g., swamps, rivers, barbed wire fences, and minefields); introducing the threat of NBC (Nuclear, Biological, and Chemical) operations; adding new weapon systems; and conducting operations under reduced visibility and nighttime conditions.

Lessons learned from recent operations in Afghanistan and Iraq will help structure future enhancements to the RDT. The basic format for the exercises will remain the same; however, changes in the virtual environment will create new and more complex scenarios. This will further challenge the students and improve the overall effectiveness of the trainer.

The second area of additional research planned for FY04 includes extending the PC-based, platoon-level exercise to a web-enabled, SCORM-compliant application. Operating this simulation on the web and allowing multiple students to participate in key leadership positions in a collaborative environment will also greatly enhance the usefulness of the trainer.

The third area of additional research will focus on the development of an Intelligent Tutoring System (ITS) and incorporating the ITS in the RDT. An ITS is an evolving form of technology that can evaluate and track a student's performance in a training environment. It can provide coach-like or instructor-like assistance to students during a training session. It can also modify future training scenarios based upon a student's past performance. An ITS can produce an individualized educational experience through instructorless mentoring; thereby advancing the ADL goal of providing tailorable training for soldiers anytime, anywhere.

The fourth area of research will be to evaluate the effectiveness of the trainer in improving student knowledge and decision-making skills. Clearly, both the USAIS and the system developers expect to see a significant improvement in student performance; however, additional research is needed to document the effectiveness of the RDT on individual soldier readiness.

CONCLUSION

Advanced distributed learning technologies are playing an increasingly important role in the way DOD will train soldiers in the 21st century. Advances in computer technology and telecommunications provide trainers with new options for overcoming a variety of constraints that limit training effectiveness. These technologies came to bear in the research and development project conducted by the USAIS and the RDECOM STC to develop a low-cost, rapid decision trainer in support of IOBC live-fire exercises.

From its conception, the team of software designers and engineers worked closely with the SMEs from the USAIS to lay the groundwork for the successful development of the RDT. The team created a highly effective, low cost, open-sourced, game-engine technology. Most importantly, the team delivered an effective training tool on time and within cost.

The design team envisions follow-on research and development of the RDT building on the current framework to create an even more intricate and effective trainer. The addition of enriched scenarios and an Intelligent Tutoring System will enhance the RDT, further demonstrating the value of ADL technologies to help transform the way the Army will train soldiers in the future.

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