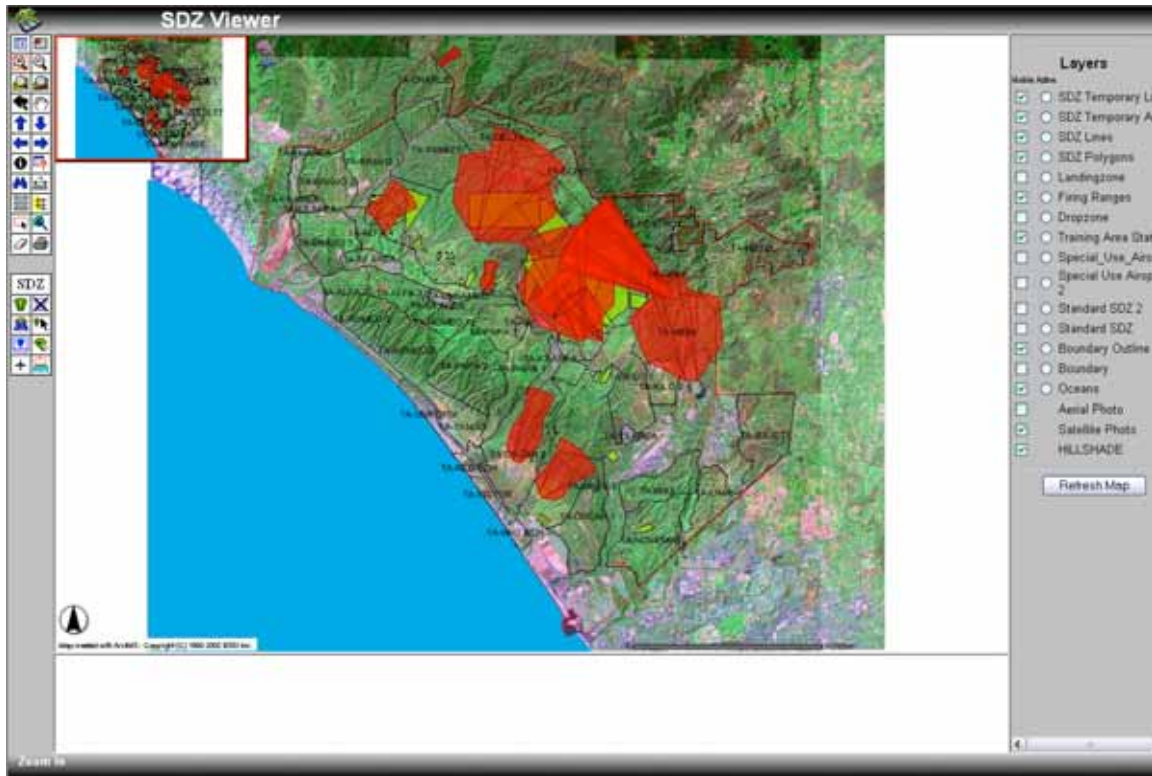


Title: ArcGIS Server Solutions for Ranges Safety in the USMC

Author: *Carlos Hathcock, David Brooks, Daniel Levine*

Abstract: The Range Safety Office of the Training and Education Command (TECOM) of the U.S. Marine Corps has been using an ArcGIS desktop solution, the Range Managers Toolkit (RMTK), for creating and managing Surface Danger Zones (SDZ) for live fire training exercises. In a desire to work jointly on the development of the RMTK application TECOM has been working side by side with the Army for several years in the development of this application and range safety standards. This joint endeavor ensures that specific weapons platforms, munitions and training concerns are coordinated among the services.



The desktop ArcGIS application provides an invaluable resource to Range managers and staff at TECOM and the Army but there was desire to also provide this functionality to unit commanders that were actively planning training events for their Marines. TECOM decided to implement a server based SDZ system that would be tightly integrated with their existing scheduling system. TECOM had also invested in a robust ArcIMS site that provides distributed GIS views for all Training Ranges. Their desire was to begin migrating the desktop GIS tools used by Range Managers to the ArcIMS system so they could take advantage of the investment in their IMS system, rich data holdings, and distribution system. The first application migrated was the SDZ component of the RMTK, specifically creating SDZs, managing the SDZ Library, and creating printable maps of each SDZ function. Through a spiral development process the USMC is implementing additional functions of the desktop application in a web environment.

The architectural environment consists of an Oracle Database, ArcSDE 9, ArcIMS 9, and ArcGIS 9 Server, ArcGIS server was a natural inclusion because the application had been prototyped as a focused desktop system and the USMC required that the server version appear and perform just like the desktop application. By bringing in SDE, TECOM was able to use the best GIS data that each of the bases had to offer and load it into the system. High resolution color imagery, elevation files and numerous other layers of data were loaded into the SDE database for use. This high resolution imagery has helped to provide for a very accurate basemap and more accurate SDZ's.

Geographic Information Services, Inc (G/I/S) was originally contracted by the U.S. Army, National Guard Bureau, and the USMC to create the SDZTool that worked inside of ArcGIS and could generate SDZs for all SDZs defined in the DA PAM 385-63. This includes weapons ranging from 9mm pistols through Multiple Launch Rocket Systems (MLRS). The first version of the Tool was completed in July 2003 and deployed by the USMC. The Army delayed release pending results of a rigorous review. The Army released of Version 2 of the SDZ tool on February 20 2004. Both services are distributing the tool through there respective web sites (Army Knowledge Online: <https://www.us.army.mil> USMC: <http://rtam.tecom.usmc.mil>)

In preparation for this server version of the RMTK desktop application, the desktop application needed some re-engineering. An SDZ API was created to separate the "SDZ Geometry Engine" with the "interface". Classes and subclasses were created to divide up major pieces of the SDZ engine and considerable time was spent ensuring a proper "handshake" between the user, IMS, ArcGIS Server and SDE. Feature classes that were created from the application were written back to the SDE database using the SDE api.

Finally, security in a multi-user system was addressed. The USMC wanted to ensure that they could control who was allowed to create SDZ's at specific installations. This was accomplished by organizing data by installations as separate owners and feature classes and setting up each of the web services with the appropriate level of user permissions.

The training environment can be very dynamic due to weather, logistics and timing and shifting plans would cause new SDZ's to be computed to ensure continued safety. While internal quality control processes have prevent the errors from impacting training safety the process is inefficient and time consuming.

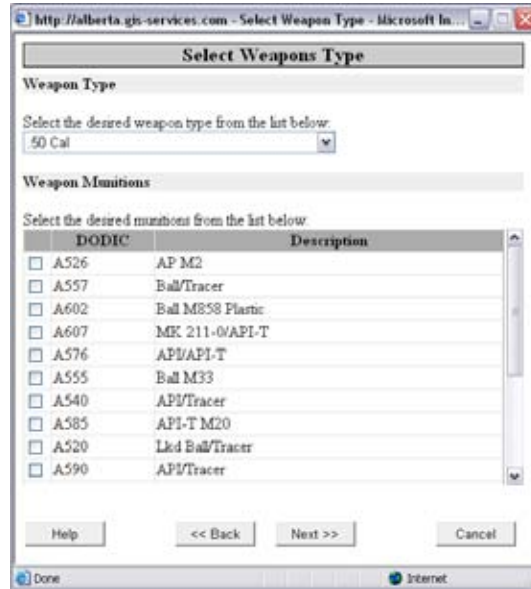
The tool works similarly in the desktop and server version and provides significant improvements to the previous by-hand process while following the basic workflow entirely within an ArcGIS environment. The desktop application is approved for ArcGIS 8.3 and 9.0 and the server version is being written for ArcGIS Server 9.

The process is simply:

Select the Weapons class



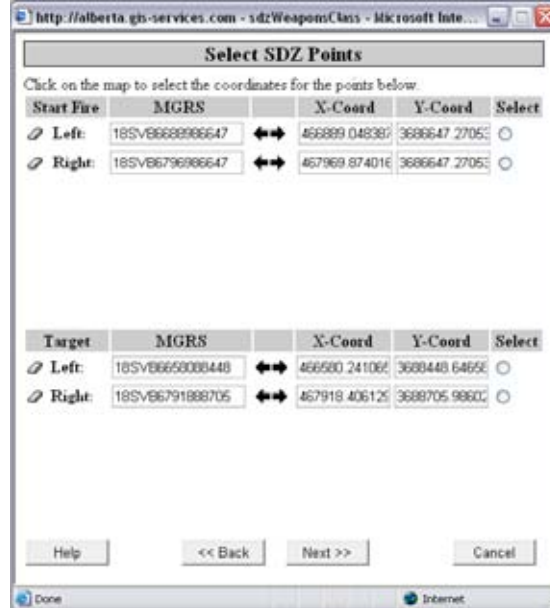
Select the Weapon and munitions to be fired



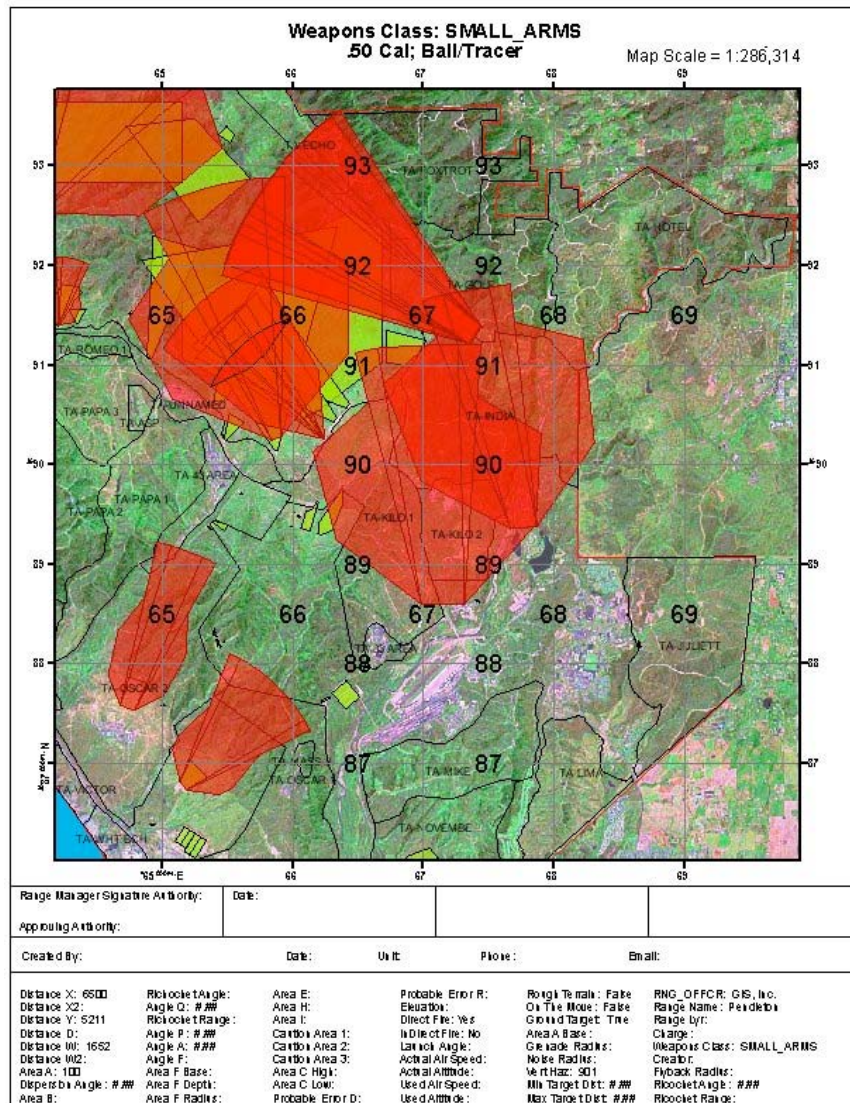
Select Firing and Target conditions



Identify Firing Points and Targets



Draw the SDZ



The training environment can be very dynamic due to weather, logistics, timing and shifting plans that would require new SDZ's to be computed to ensure continued safety. While internal quality control processes prevent the errors from impacting training safety the process is inefficient and time consuming. The application provides numerous efficiencies throughout the process. The user is prompted for any required information and cannot proceed without providing that. Any weapons system related requirements are built into the internal error checking. For instance many weapons have both minimum and maximum firing distances due to either safety or effective range. The application uses its weapons database to compare distance to targets against this information and will prompt the user to move firing points or targets to appropriate distances to meet these requirements. The application will draw the resulting SDZ first as a graphic feature and if the user is satisfied with the result the user can then save the SDZs and related data to

Current development activities include adding a Noise Component to the application. CERL is developing a “simplified” version of both Bnoise and SARNAM, currently used to develop noise contours for large weapons and small arms respectively. This simplified application will be integrated into the SDZTool allowing the Range operations personnel to generate noise contours for any event tied to an SDZ. Additionally, the USMC has funded an effort to incorporate the Navy methodology for developing Laser Hazard Danger Zones (LHDZs), 3D visualization of Ranges and limited use airspace and the analysis and display of on range Explosive Safety Quantity Distance (ESQD) arcs for temporary munitions storage. Each of these capabilities will be incrementally added to the web version.

As this application continues to progress it is expected to interface with the USMC’s scheduling and control application RFMSS. This will allow unit commanders the ability to work out a safe training plan, de-conflict with those training around him and submit it for final approval. An activity that used to take months of coordination and meetings can now be done in minutes.

Author 1: Carlos Hathcock, Gy, U.S. Marine Corps, Retired.
Hathcockcn@tecom.usmc.mil (703) 784-2841

Bio: Carlos Hathcock served in the United States Marine Corps for over twenty two years. He currently works for the Training and Education Command, Quantico, Virginia.

Author 2: David Brooks, Director of Sales, Geographic Information Services, Inc. 14120 Tattershall Place, Germantown 20874. dbrooks@gis-services.com (301) 529-1574.

Author 3: Daniel A. Levine, Director, Federal Programs. Geographic Information Services, Inc. 216 Aquarius Drive, Suite 319 Birmingham AL 35209 (205) 941 0442.