

## **Testing and Training Convergence – Common Scenario Generation Requirements and Solutions**

**Roy Scrudder, Kevin Gupton**  
**Applied Research Laboratories**  
**The University of Texas at Austin**  
**Austin, Texas**  
**roy.scrudder, kgupton@arlut.utexas.edu**

**John Diem**  
**US Army Operational Test Command**  
**Fort Hood, Texas**  
**john.w.diem.civ@mail.mil**

### **ABSTRACT**

Scenario generation for simulation-enabled environments (particularly for events with integrated mission command systems and networks) is a time-intensive, complicated task involving many data sources and a variety of tools. Historically, the testing and training communities have created and maintained separate scenario generation and database population capabilities to meet their specific test requirements. The absence of collaborated solutions is commonly due to unproven assumptions that scenario requirements between the two communities are vastly dissimilar. The Army Operational Test Command (OTC) is committed to investing in and employing common testing-training solutions to the maximum practical extent. Thus, the command conducted an analysis of scenario generation capabilities in 2016, to explore the potential for cross-community solutions. Additionally, OTC has launched a major test technology investment, the Integrated Live-Virtual-Constructive (LVC) Test Environment (ILTE) program, with a charter to establish and fund common test and training capabilities.

OTC's initial analysis focused on the testing of intelligence, surveillance, and reconnaissance (ISR) sensor platforms and information systems. OTC performed this analysis to inform a decision on replacing or updating its Intelligence Modeling and Simulation for Evaluation (IMASE) Scenario Generation Tool (ISGT). ISGT, developed and used by OTC since 2007, has become unsupportable based on cost and evolving data requirements. OTC sought a common, cross-community solution that could replace ISGT as well as address broader simulation-mission command environments. This paper describes the development of scenario generation requirements using ISGT as an initial basis, and then compares those requirements with scenario generation capabilities employed by the training community. These tools include the Exercise Design Tool (EDT), Web Military Scenario Development Environment (WebMSDE), Intelligence and Electronic Warfare Tactical Proficiency Trainer (IEWTPT), and Joint Training Data Services (JTDS). No single scenario generation tool (to include SGT) met all ISR test requirements. However, the analysis revealed that a combination of training community tools (with some tool augmentation) could support all necessary scenario generation processes for ISR testing as well as broader T&E and training applications. As a result, OTC has begun acquisition and implementation of those capabilities.

### **ABOUT THE AUTHORS**

**ROY SCRUDDER** is the Program Manager for the M&S Engineering Group at the Applied Research Laboratories, The University of Texas at Austin (ARL:UT). He has over 35 years' experience in information systems analysis and development, concentrating the last 25 years in information management for M&S. Mr. Scrudder also served as the Associate Director for Data Management at the DoD M&S Coordination Office. He has been involved in a data management and systems engineering activities for many DoD programs, including the Integrated LVC Test Environment, Joint Strike Fighter, Data Management for Distributed Testing, Enterprise Data Services, and most recently the ITE Product Line. Mr. Scrudder's professional experiences are in the areas of data management and data engineering with a specialization in metadata. He holds a B.S. in Applied Mathematics from the University of Tennessee.

**JOHN DIEM** is the Interim Executive Director and Director of the Test Technology Directorate for the US Army Operational Test Command (OTC) of the Army's Test and Evaluation Command (ATEC). He has over 35 years' experience in the development, integration and employment of simulations to support Army, joint, and coalition training environments from battalion to theater and in support of developmental and operational testing, particularly

in the testing of mission command systems and networks. In his current position, he is leading ATEC's efforts to implement a sustainable real-time casualty assessment (RTCA) capability that is enabled by cross-community solutions for tactical engagement, networks, data collection, and mission command simulation. Previous positions include Deputy Director, DoD M&S Coordination Office, and G3, III Corps. Mr. Diem's professional experiences have concentrated on simulation-mission command system integration and have included multiple programs that employed and fielded cross-community solutions for simulation and simulation support tools. He holds B.A. and M.S. degrees from Texas A&M University.

**KEVIN GUPTON** is an Engineering Scientist in the Modeling and Simulation Information Management Group at ARL:UT. He has over 14 years of experience in enterprise system engineering, data modeling, and knowledge management. Mr. Gupton has developed net-centric applications and data services utilizing C4I and M&S common data standards and ontologies. He holds a Bachelor of Science in Mathematics and a Master of Science in Computer Science from Texas A&M University.

## **Testing and Training Convergence – Common Scenario Generation Requirements and Solutions**

**Roy Scrudder, Kevin Gupton**  
**Applied Research Laboratories**  
**The University of Texas at Austin**  
**Austin, Texas**  
**roy.scrudder, kgupton@arlut.utexas.edu**

**John Diem**  
**US Army Operational Test Command**  
**Fort Hood, Texas**  
**john.w.diem.civ@mail.mil**

### **INTRODUCTION**

One of the most lengthy and resource-consuming processes for any large-scale simulation application is scenario generation. It can take weeks, or even months, to produce the necessary scenario products to drive a simulation supported event. This is a reality across communities that employ modeling and simulation (M&S), including testing, training, experimentation, and analysis. Just as each community (and even a group within a community) often has a different set of models and simulations that they use, they also typically employ different scenario generation tools. Those scenario generation tools are often tied specifically to the models and simulations they use. General-purpose scenario generation tools are the exception, even though the communities apply the same fundamental scenario generation processes. The simulation-specific features of these tools often come down to differences in data formats produced rather than differences in information content.

The result is that the US Department of Defense (DoD) expends valuable resources to sustain a wide variety of separate scenario generation tools that perform many of the same functions. In addition to the cost associated with developing and sustaining multiple tools, there is a secondary cost in training personnel to use different tools.

The Army Test and Evaluation Command (ATEC) is an exemplar of an organization that has developed and sustained its own scenario generation capabilities. Although their intent was to have a common set of tools to support both developmental and operational testing, the reality is that there is currently divergence in the tools used across these two parts of the same community within the Army. ATEC's Operational Test Command (OTC), which currently sustains the scenario generation tools for developmental and operational tests, conducted an analysis to see if there was potential to focus OTC investments and align OTC investments and tools with other Services and Communities. Further, OTC leadership questioned whether the Army Testing Community needed to have its own testing-specific scenario generation tools, or if there was an opportunity to leverage the larger Army and DoD investments made by others. OTC already uses many of the same simulations as the Army training community and, in some cases, has been co-sponsors, funding agents, and co-developers. These simulations include the Joint Conflict Analysis and Training Simulation (JCATS), the One Semi-Automated Force (OneSAF), Virtual Battle Space 2 and 3 (VBS2/VBS3), and the Multiple Integrated Laser Engagement Simulation (MILES). Conversely, other communities leverage OTC's simulation capabilities and enhancements. A prime example is the Extensible C4I System Fire Support Application (ExCIS FSA), which is now widely used as a key component of multiple Army training federations, for experimentation and developmental testing, and at Army training centers.

To a large extent, simulations include custom scenario generation tools; for example, the OneSAF Management and Control Tool (MCT) enables scenario generation for OneSAF. OTC wanted to know if more general-purpose, simulation-agnostic, scenario generation tools could be used to fully or partially meet their needs. If so, then those tools will become the test planning and preparation tools the command's Integrated Live-Virtual-Constructive (LVC) Test Environments (ILTE) program. The ILTE test planning and preparation subsystems will ultimately include test planning, scenario generation, design of experiments (DoE), database population, and network planning and analysis tools. OTC believes a large majority of those capabilities will also be of great utility to other M&S applications and users.

This paper reports on the ensuing analysis. To keep within a tractable scope, OTC decided to start the analysis in the specific area of scenario generation to support developmental and operational testing of intelligence, surveillance, and reconnaissance (ISR) sensors and information systems. We begin by describing the current state of scenario generation for the ISR testing domain—both the original intent and the current practice. We will then lay out how the analysis was conducted—defining use cases and requirements, then comparing scenario generation tool capabilities to the requirements. Finally, we will define a set of alternative solutions for a possible future approach to employing scenario-generation tools.

## **CURRENT STATE OF SCENARIO GENERATION FOR ISR TESTING**

Since the late 1970s, OTC and its predecessors have developed high fidelity simulation systems for use in the testing of intelligence fusion, ground station, and sensor management capabilities, primarily as part of the Tactical Simulation (TACSIM) program. TACSIM ultimately became the common ISR simulation for training and operational testing events through the 1980s and 1990s. However, one of the greatest impediments to using TACSIM was the time and expertise needed to configure and script a scenario to drive ground and air movement, threat emitter activities, and friendly sensor deployments. Even when federated with the Corps Battle Simulation (CBS) to leverage that simulation's ground and air movement activities, it still took months to develop the intelligence and opposing force (OPFOR) technical elements of the scenario.

In the late 1990s, ATEC launched an aggressive intelligence-simulation modernization program that could support both developmental and operational testing of ISR sensors and information systems—the Intelligence Modeling and Simulation for Evaluation (IMASE) capability—and has sustained it since. IMASE addressed the scenario generation gap in TACSIM with a modern system design for processing, sensor model updates, test control and visualization, simulation federation and control, and analytical tools to support test event scoring and evaluation. To accomplish these objectives, IMASE contained three subsystems to be operated stand-alone or together:

- **IMASE Scenario Generation Tool (ISGT)** – Converts US Army Training and Doctrine Command (TRADOC) Defense Planning Guidance (DPG) unit-based scenarios down to individual systems level definition. ISGT converts the scenarios to time-ordered event lists (TOELs) that test planners and test system operators use to replicate threat actions and signals.
- **IMASE Sensor Interface System (ISIS)** – Develops and delivers sensor stimulation inputs, based on ISGT-generated scenario scripts. ISIS product control transmissions from open-air threat system simulators that stimulate sensor systems and packages.
- **IMASE Simulation & Scoring Subsystem (ISSS)** – Executes the ISGT generated scenario. ISSS operates within a live-virtual-constructive federation to provide the friendly intelligence-sensor collection models, soldier product development, product delivery, and scoring utilities.

IMASE is another example where a specific scenario generation tool was developed for a simulation, or in this case, both a simulation (the ISIS federation) and a stimulation capability (ISIS).

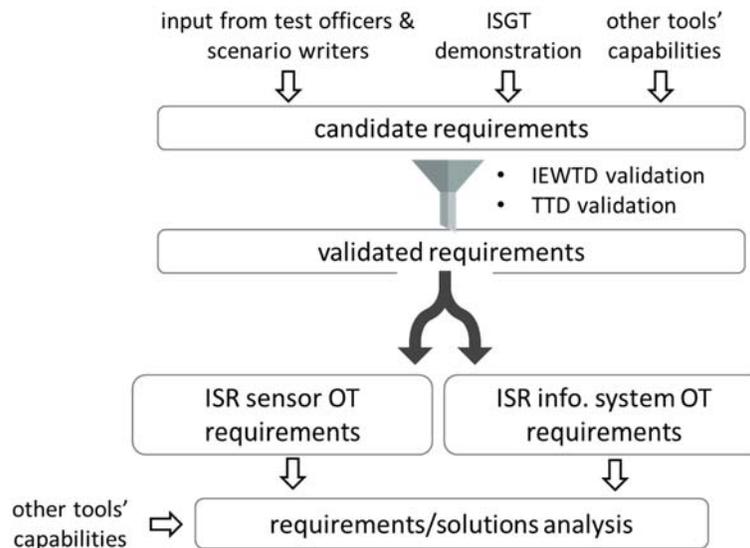
Over the past two decades, IMASE subsystems have been used very successfully to support both developmental and operational testing of individual ISR sensor platforms such as the Tactical Signal Intelligence (SIGINT) Payload (TSP) and ISR information systems such as the Distributed Common Ground System-Army (DCGS-A). However, testers never used the IMASE subsystems as planned—as a tightly coupled, integrated system. Test planners used ISGT to create part of the scenario for ISIS, but created other parts in Microsoft Office. For some operational tests, ISGT has been used to create “road to war” products to set the context for events that use ISSS. However, test planners generate the bulk of the ISSS scenario outside of ISGT, using a collection of simulation-specific tools (e.g., OneSAF MCT), Microsoft Office, and direct editing within scenario databases. In several recent events, last-minute changes in the test scenario rendered the ISGT “road to war” unusable to ISSS.

Severe reductions in OTC's test technology sustainment funding line (50% reduction from 2012 to 2017) as well as increased desire (as reflected in the command's ILTE acquisition strategy to promote common simulation tools) has led OTC to a decision to retire its IMASE program by 2019. This study has directly contributed to those decisions and will be used to inform OTC investment decisions and an Army G2 and ATEC-led review of intelligence test capabilities during FY18.

## ANALYSIS OF CURRENT ISR SCENARIO GENERATION CAPABILITIES

### Analysis process

Figure 1 below depicts the process of defining requirements for ISR scenario generation. This process relied on a variety of sources to define candidate requirements and then validated whether those were real requirements, “nice to have” features, or functions that were not applicable to ISR scenario generation. The first step was to decompose the functionality of ISGT to document the baseline, or “as-is” capability. The ISGT user’s manual and an ISGT demonstration by ATEC’s Information and Electronic Warfare Test Directorate (IEWTD) were the sources used to reverse-engineer these functionalities. That is not to say that just because ISGT could perform a function, it was needed to support the current scenario generation process. Nor was it assumed that ISGT met all requirements for scenario generation. At this stage, the ISGT characterization established the initial set of candidate requirements for the objective scenario-generation capability.



**Figure 1. Requirements and Solution Analysis Process**

Next, a set of commonly available scenario generation tools were analyzed using their user documentation and (where available) requirements specifications. The full set of scenario generation tools analyzed was:

- IMASE Scenario Generation Tool (ISGT) – sustained by the Intelligence Electronic Warfare Test Directorate (IEWTD).
- Intelligence and Electronic Warfare Tactical Proficiency Trainer (IEWTPT) Intel Low Overhead Driver (iLOD) – IEWTPT provides Military Intelligence (MI)-specific Warfighting-Function training at home stations to support the sustainment of critical individual and collective tasks, skills, and Army Force Generation. iLOD contains the IEWTPT scenario generation capability (General Dynamics C4 Systems, 2015).
- Training Brain Repository Exercise Design Tool (TBR EDT) – a web hosted application that guides soldiers and exercise planners through the exercise design process, supplanting a manual, MS Office-based process (TRADOC G27, 2016)
- Web Military Scenario Development Environment (WebMSDE) – a web browser based tool for generating military scenarios in simulation-independent formats. PEO STRI maintains WebMSDE. (StackFrame, 2014).
- Joint Training Data Services / Order of Battle Service (JTDS OBS) – JTDS a web-based suite of classified and unclassified authoritative databases and tools used by data production centers, event preparation centers, and deployed exercise sites for the creation of correlated, initialization-ready

scenarios for analysis, experimentation, training, exercises, mission planning, and mission rehearsal events. (Joint Staff J7, 2012).

- Extensible C4I Instrumentation Suite Fires Support Application (ExCIS FSA) – the Fires Test Directorate (FTD) developed ExCIS FSA to simulate fire support command and control systems (CAT, 2014).
- OneSAF Management & Control Tool (MCT) – Provides scenario generation functions to OneSAF.

The functionalities of these exercise and scenario tools were also considered as candidate requirements and were combined with those from the ISGT analysis. An analysis of scenario generation requirements from ILTE Test Capability Requirements Document (TCRD) (OTC, 2014) was used as an additional source of candidate requirements. This resulting set of candidate requirements were then augmented by interviewing scenario developers in the two ATEC organizations responsible for ISR scenario generation—specifically, staff from IEWTD and the OTC Test Technology Directorate. As part of the same process, those two organizations validated whether the candidate requirements described above were critical requirements, nice-to-have features, or not needed to support their scenario development needs. As will be described later, the use cases for testing individual ISR sensors and ISR information systems such as DCGS-A are different, so separate validation reviews occurred for these two respective use cases. The starting assumption (which bore out during the analysis) was that the scenario-generation tool requirements for these two use cases could be different. The results of this phase of the requirements analysis was accomplished using Excel spreadsheets.

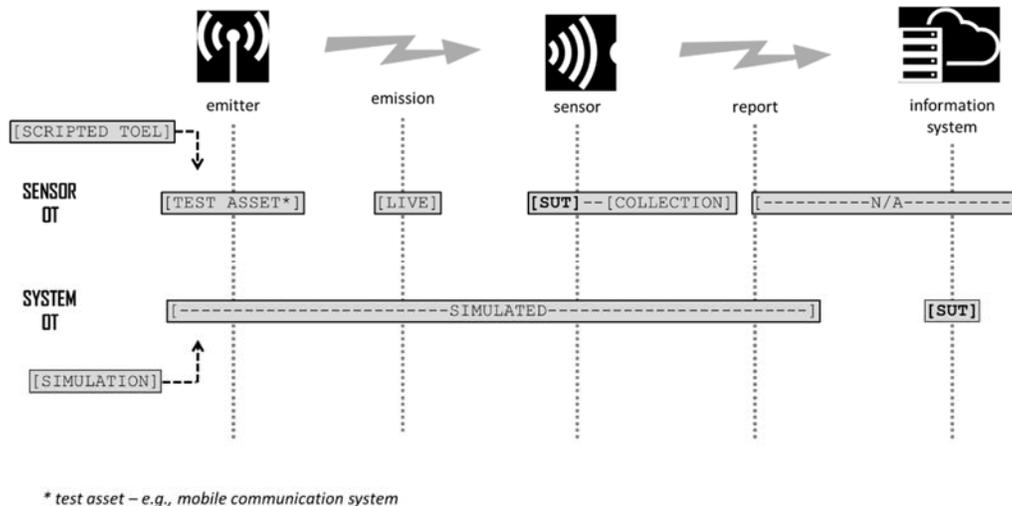
A secondary check on the requirements' validity was performed by documenting the scenario-generation processes for the sensor and system use cases. This provided a “clean sheet” check for the completeness and consistency of the requirements established by tool analysis and expert validation.

The result of this analysis was a thorough documentation of the scenario generation processes for ISR sensor and system tests, a set of functional requirements, traceability from the processes to the requirements, and documentation of which requirements could be met (either partially or fully) by each tool. This documentation was in the form of DoD Architecture Framework (DoDAF)-compliant (DoD CIO, 2017) operational and service views created using the Sparx Enterprise Architect tool.

As will be discussed in more detail later, no single scenario generation tool could meet all the requirements. So the final step was to develop courses of action where combinations of tools—with modification of the tools in some cases—could potentially be used to satisfy the requirements.

### **Use cases**

The two operational test (OT) use cases for scenario generation were 1) the testing of individual sensor platforms, such as TSP or Prophet, and 2) testing of ISR information systems such as DCGS-A. Figure 2 describes these two use cases and highlights their differences.



**Figure 2. ISR Testing Use Cases**

For sensor testing, the key focus is generation of a TOEL, which is used to drive live, free-space emitters that stimulate the system under test (SUT). Although tests are typically conducted as “free-play” exercises resembling field training exercises (FTX), command post exercises (CPX), or communications exercises (COMMEX), the test scenarios are sometime supplemented with these TOEL scripted activities to ensure specific data are collected, such as for assessment of key performance parameters (KPPs) and key system attributes (KSAs) of the systems under test (SUTs). A TOEL is produced by scripting a military operation (initial forces laydown and scheme of movement) using a scenario generation tool. The scenario generation tools are then used to lay down a communications/emissions script and results in the time-ordered, geo-referenced, set of emissions that form the TOEL. The ISR sensor under test capture the emissions and generate intelligence reports for processing by an ISR information system.

In an operational test of an ISR information system, generation of emissions and detection by sensors are all simulated. As with a sensor test, the scenario starts with a laydown and planned scheme of maneuver. But, unlike the sensor-test use case, emissions are not scripted in advance. Rather, simulated emissions are generated from execution of the scenario in a constructive simulation environment.

### Functional requirements

Utilizing the previously described process of requirements generation and validation, 170 requirements were captured across 12 categories, using an Excel spreadsheet. In a full requirements decomposition, many of these 170 requirements could be further decomposed as multiple functional requirements. An example of such a requirements would be the ability to create, edit, and delete a test range configuration (which could be decomposed as three atomic requirements). For this analysis, going into that full decomposition level of detail was not necessary. The requirements categories and counts of validated high-level requirements in each category were:

- Test/Exercise Planning (31 requirements) – ability to create an overall test/exercise plan.
- Basic scenario (10 requirements) – ability to create, edit, manage, and validate an overall scenario.
- Force structure (13 requirements) – ability to define the forces in a scenario including personnel, platforms, and equipment
- Communication (10 requirements) – ability to define the networks in the scenario
- Classes (11 requirements) – ability to define “types” which are instantiated in a scenario, e.g., equipment types, force templates, etc.
- Environment (5 requirements) – ability to edit the geospatial content of the scenario.
- Tasks & Orders (30 requirements) – ability to edit planned actions in a scenario
- Scripted events (34 requirements) – ability to edit the time-ordered event list
- Simulation/Instrumentation (5 requirements) – ability to allocate the scenario elements to LVC components

- Reference libraries (3 requirements) – ability to manage reusable libraries used to create scenarios
- TCRD-derived (12 requirements) – additional functional requirements derived from the high-level scenario generation in the TCRD
- Tool Infrastructure (6 requirements) – non-functional requirements that define the environment in which the scenario generation tool must execute.

To validate these requirements, IEW and Test Technology Directorate personnel were asked whether these capabilities were needed to support the two use cases—sensor and ISR information system tests. For the 170 requirements above, the following resulted from the validation:

- All 170 of the requirements are valid for one, the other, or both of the use cases (sensor tests and/or ISR information system test).
- 116 of the requirements are valid for sensor test
- 8 of the requirements are valid for ONLY sensor tests (they are not applicable for ISR information system)
- 162 of the requirements are valid for ISR testing.
- 54 of the requirements are valid for ONLY ISR information system testing (they are not applicable for sensor tests)
- 108 of the requirements apply to BOTH sensor and ISR testing.

### Evaluation of scenario generation tools

Each of the scenario tools was evaluated for its ability to satisfy the 170 requirements. Three ratings were possible—1) fully supports the requirement, 2) partially supports the requirements, or 3) does not support the requirement. The analysis team made these assessments using a variety of information sources as shown in Table 1. For all of the scenario generation tools, the analysis team had access to the User's Manuals. Those manuals implied the functional capabilities and helped organize the requirements. For TBR EDT, Web MSDE, and JTDS OBS, a member of the analysis team had online access to the tools. At least one member of the analysis team received demonstrations of each of the tools. Finally, for all of the tools except JTDS, the analysis team interviewed subject matter experts (developers or frequent users).

**Table 1. Analysis Sources**

Tool	Demonstration	Interview	Users Manual	Direct Use
ISGT	User	User	Yes	
IEWTPT iLOD	User	User	Yes	
TBR EDT	User	Developer	Yes	Yes
WebMSDE	Developer	Developer	Yes	Yes
OneSAF MCT	User	User	Yes	
JTDS OBS	-	-	Yes	Yes
ExCIS	Developer	Developer	Yes	

Table 2 breaks down the ratings for each tool for each of the use cases — 116 requirements for sensor tests and 162 for ISR information system tests. Table 2 summarizes the totals for each tool across the two use cases. Clearly, none of the scenario generation tools can meet all of the requirements for either use cases. ISGT comes the closest, but it only meets 81% (94 of 116) of the requirements for sensor tests, and 59% (96 of 162) of the requirements for ISR information system tests.

**Table 2. Tool Support for Use Cases**

Scenario Generation Tool	ISR Sensor Use Case			ISR Information System Use Case		
	Full support	Partial support	No support	Full support	Partial support	No support
ISGT	94	-	22	96	-	66
IEWTPT iLOD	19	6	91	48	7	107
TBR EDT	39	8	69	51	12	99
WebMSDE	16	5	95	34	5	123
OneSAF MCT	17	-	99	27	-	135
JTDS OBS	16	-	100	24	-	138
ExCIS	6	-	110	11	2	149

Given that no one tool can meet all requirements, a more in-depth analysis of these results was performed, where the requirements were summarized by the categories described earlier. The results from that analysis are shown in Table 3. In this table, the ratings are a summary across the two use cases.

**Table 3. Tool Support for Requirements Categories**

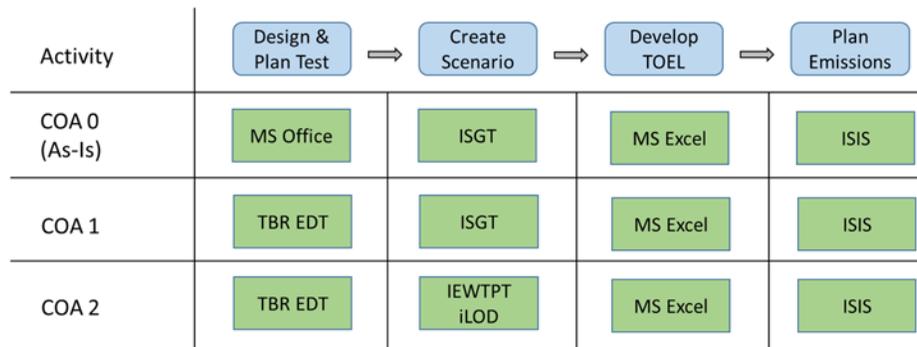
Scenario Generation Tool	Test/Exercise planning	Basic Scenario	Force structure	Communication	Classes	Environment	Task & Orders	Scripted events	Simulation/instrumentation	Reference libraries	Misc. TCRD Crosswalk	Tool infrastructure
ISGT	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Red
IEWTPT iLOD	Red	Green	Green	Yellow	Green	Green	Green	Yellow	Red	Yellow	Yellow	Yellow
TBR EDT	Green	Yellow	Green	Red	Red	Yellow	Green	Yellow	Red	Yellow	Red	Green
WebMSDE	Red	Yellow	Yellow	Red	Green	Red	Green	Yellow	Yellow	Yellow	Red	Yellow
OneSAF MCT	Red	Yellow	Yellow	Red	Green	Red	Red	Red	Yellow	Yellow	Red	Green
JTDS OBS	Red	Yellow	Yellow	Red	Green	Red	Red	Red	Yellow	Yellow	Red	Green
ExCIS	Red	Yellow	Red	Red	Yellow	Red	Red	Yellow	Red	Red	Red	Red
Legend	Green	Fully meets requirements										
	Yellow	Partially meets requirements										
	Red	Does not meet requirements										

As with the comparison across use cases, ISGT has the best coverage across the requirements categories. It was found lacking in both the tool infrastructure category—the major shortcomings related to collaborative scenario development and requirements established in the ILTE TCRD. Compared with ISGT, IEWTPT iLOD comes the closest to covering

the ISR testing-specific requirement. Among the general-purpose scenario editors, JTDS was not found to be a good match for this domain or the level of simulation. Both the OneSAF MCT and its intended replacement WebMSDE cover many of the requirements for basic scenario generation. Between these two tools, WebMSDE provides support for editing tasks and order and scripting events not found in the MCT. ExCIS also does not rate well in this domain, but that is not surprising, given that it is optimized for use in the fires domain. While the TBR EDT does not score well in the domain of ISR test scenario generation (particularly the requirements for specifying emitter and sensor modes and configurations), it is the only tool evaluated that provides good support for exercise planning. While these tools were developed specifically for the training community, they appear to translate well to test-event planning.

### COURSE OF ACTION ANALYSIS

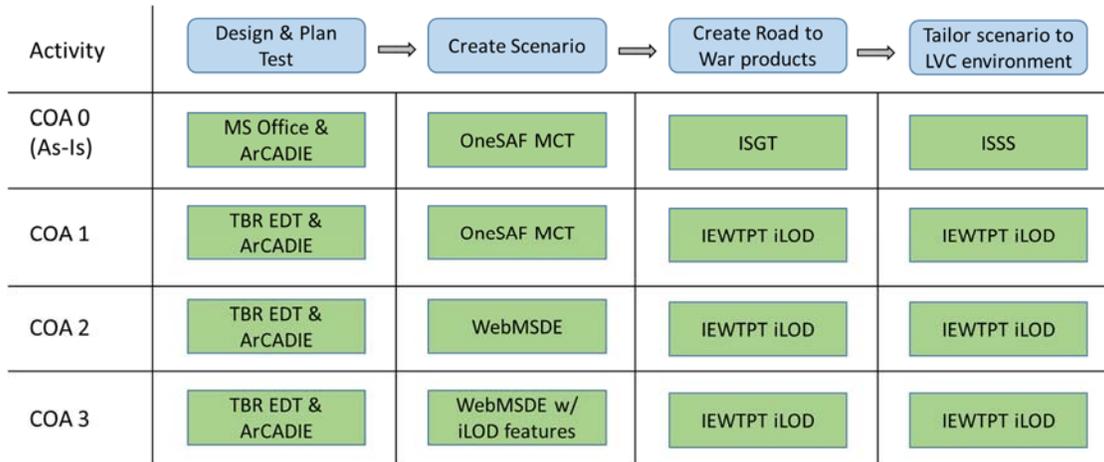
The final step in the analysis was to determine a set of alternative courses of action (COAs). These COAs were expressed using DoDAF service views created using Sparx Enterprise Architect. Given the difference in requirements for sensor and ISR information system tests, separate sets of COAs were developed for these two use cases. Figures 3 and 4 describe the COA sets for sensor and ISR information system tests respectively. Commonality of tools to support the two use cases was a goal, but ultimately, the value of the COAs was assessed based on whether they could independently meet the requirements of the respective use cases.



**Figure 3. ISR Sensor Test Scenario Generation Courses of Action**

For ISR sensor tests two alternatives to the baseline as-is COA 0 were examined. COA 1 prescribes the TBR EDT in place of M&S Office (Word, Excel, and PowerPoint) for designing and planning a test. Using this approach, a common automated tool would be used through the design and planning process. This would drastically improve the consistency and maintainability of design and planning products. It would also provide an ability to use the common products that define a scenario at the conceptual level in the simulation subsequent scenario creation process. The primary tasks to implement this COA would be to adapt the training-centric TBR EDT to support test needs and to integrate TBR EDT outputs with ISGT inputs. The shortcoming of this COA is that it still involves sustainment of ISGT.

COA 2 for sensor tests would be to adopt the TBR EDT and to use the IEWTPT iLOD to generate the scenario starting conditions as well as to generate the TOEL. The primary benefit of this COA is that using the IEWTPT iLOD training tool alleviates the need to maintain ISGT. However, it does require a paradigm shift from manually producing TOELs to either simulation-produced TOELs or simulation-driven tests. The tasks involved to implement this COA include the EDT work from COA 1 plus improvements to iLOD to produce more granular TOELs. In both of these COAs, Microsoft Excel would still be needed to produce the final TOELs and ISIS would be used to plan the resulting signal emissions, as is the current practice.



**Figure 4. ISR information system Test Scenario Generation Courses of Action**

For ISR information system tests, three alternatives to the baseline as-is COA 0 were examined. COA 1 uses the TBR EDT in place of M&S Office (Word, Excel, and PowerPoint) for designing and planning a test. The Army's Mission Command architecture repository (ArCADIE) is used in all COAs (a side effect of past DCGS-A tests and possibly future tests occurring during Network Integration Evaluation (NIE) events). The other major feature of this COA is that ISGT is no longer used to create road-to-war products. Rather, the iLOD portion of IEWTPT performs this function, in addition to generating civilian entities and defining threat electronic order of battle. The use of TBR EDT has the same benefits here as for sensor tests—providing an automated tool that can produce information in a form usable for scenario generation. Additionally, inclusion of the iLOD training tool alleviates the need to maintain ISGT. The work to execute this COA includes integration of MCT and iLOD, integration of EDT with ArCADIE, and adaptation of EDT to support testing needs.

COA 2 for information systems tests is the same as COA 1, but utilizes WebMSDE in lieu of the OneSAF MCT for the core of scenario generation. PEO STRI has begun initial work to integrate TBR with EDT as part of a research program that has already produced promising results.

COA 3 for ISR information systems tests also utilizes WebMSDE, but in this case, WebMSDE would be modified to incorporate iLOD functions, rather than requiring separate use of WebMSDE and iLOD as scenario generation tools. While this involves more work than COA 2, it results in a more cohesive scenario generation system for users.

## FUTURE WORK

While this analysis provided emergent results that point to the potential for replacing ISGT, additional work is needed before outlining a transition plan. One other significant scenario generation exists that the ATEC team was unable to evaluate—the Scenario Generation (SGEN) tool associated with the Warfighter's Simulation (WARSIM). Schedules did not accommodate gathering information from the WARSIM team. WARSIM SGEN will be analyzed before a final decision on scenario generation is made.

While this analysis addressed functional (and limited non-functional) requirements, the programmatic feasibility of using these tools for the testing community has not been explored. The willingness of the training community to take on supporting the testing community and potentially expanding their tools to address testing-specific requirements must be examined. The associated costs for broadening the community supported by these tools must be analyzed. Decisions made from the final analysis will tie to near term investment decisions for sustaining scenario generation capabilities within the Testing Community, Test Resource Management Center (TRMC) Resource Enhancement Project (REP) projects, and long-term Program Objective Memorandum (POM) decisions.

As OTC makes these decisions, they will address broader scenario generation requirements. While this analysis focused on ISR tests specifically, OTC can expand the same methodology to address scenario generation requirements for other types of tests such as weapon platforms or Mission Command system tests.

## CONCLUSIONS

This effort was begun based on two assumptions: 1) test and training needs for scenario generation capabilities are more similar than dissimilar, and 2) OTC could retire its OT-unique capabilities without adversely affecting its testing mission, while investing in common tools that would support testing, evaluation, and other simulation user groups (training, experimentation, and acquisition). This analysis has validated both of those assumptions.

The analysis results points to a strong possibility that other tools could support the requirements currently filled by ISGT and the collection of other tools used by IEWTD and TTD. All of the alternative tools identified as promising candidates originated in and are sustained by the training community. This provides objective evidence that a large degree of commonality exists between training and testing scenario generation requirements.

Efforts throughout FY17 and FY18 will continue to support the refinement of requirements and the development of acquisition and transition strategies to retire existing IMASE capabilities and replace them will common scenario generation and test support tools. Those efforts will include an Army ISR test capabilities deep dive to assess: 1) the portfolio of intelligence and sensor systems coming to test in FY18 through FY27, 2) the current state of test capabilities to support those tests, and 3) actions in process or needs to close test capability gaps by the time test planning and preparation must begin.

In terms of the process used for this evaluation, it proved to be suitable and provided objective comparison results when applied to the use cases, the capabilities of different scenario generation tools, and courses of action. This analysis methodology should be applicable to the larger scope of scenario generation capabilities for M&S and to comparisons of other capabilities. OTC intends to use a similar methodology to identify a course of action in providing future ISR LVC capabilities. Lessons learned included the importance of surveying the user base as to the capabilities they currently require, vice assuming that they need all the capabilities of their current tools, and that those tools are sufficient to meet their needs. Establishing the use cases for the capabilities, then comparing those uses cases with the results of the requirements gathering process, proved to be a valuable requirements validation step.

## REFERENCES

- Center for Agile Technology (CAT) (2014). *Extensible C4I Instrumentation Suite (ExCIS) Installation and Operations Manual, Version 3.2.*
- DoD Chief Information Officer (2017). *DoDAF Architecture Framework, Version 2.02.*
- General Dynamics C4 Systems (2015). *Intelligence and Electronic Warfare Tactical Proficiency Trainer (IEWTPT) Technical Control Cell (TCC) Operator Manual, Version 5.0.6.1.*
- Joint Staff J7 (2012). *Joint Training Data Services (JTDS) User Guide, Version 3.4.*
- StackFrame, LLC (2014). *Web-Military Scenario Development Environment (WebMSDE) User's Manual, Version 2.5.*
- US Army Operational Test Command (OTC) (2014). *Test Capabilities Requirements Document (TCRD) for the Integrated Live-Virtual-Constructive Test Environment (ILTE), Version 1.1*
- TRADOC G27 (2016). *Training Brain Repository-Exercise Design Tool (TBR-EDT) User Guide, Version 1.3.4.*