# 19th ICCRTS

# The Scenario Development Tool: Enabling Planners to Develop and Refine a Plan at a Rapid Pace

## "C2 Agility: Lessons Learned from Research and Operations"

## Topics

Experimentation, Metrics, and Analysis
Modeling and Simulation
Architectures, Technologies, and Tools


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# The Scenario Development Tool: Enabling Planners to Develop and Refine a Plan at a Rapid Pace


## Abstract

Military planners are frequently tasked with developing a complicated plan in a short amount of time while employing minimal resources. Current planning processes are conducted manually and planner must collaborate through face-to-face or digital communications. We propose a software planning tool that will use an existing simulation to allow planners to input a variety of controllable and uncontrollable variables. The Scenario Development Tool (SDT) will then execute the underlying simulation and present the user with response surfaces. While limitations exist, the SDT has the potential to be a valuable tool for all military planners. The tool has achieved an initial capability and is able to run on a limited scenario. Initial results and future potential are discussed.

## Problem Statement

Recently, military commanders have sought to train the way they intend to fight. In order to accomplish this task, numerous techniques, programs, and methods have been adopted over the years resulting in a myriad of various doctrines, programs of record and a veritable alphabet soup of Three-Letter Acronyms (TLAs). The purpose of these artifacts is to provide a commander with a better plan more quickly; and they are successful in accomplishing this goal. However, the planning process is extremely time and labor intensive, leading to greater expenses and higher levels of coordination required reaching a final plan. Among these methods are the Joint Operational Planning Process (JOPP) and Homeland Security Exercise and Evaluation Program (HSEEP).

In fact, the state of operational planning has changed little in the last hundred and fifty years. In 1857, General Helmuth von Moltke (German Army) instituted a planning process similar to what we still use today, with an emphasis on commander's intent and allowing subordinate commanders a degree of flexibility to act within a senior commander's guidelines [1]. The JOPP, as described in the Joint Publication 5-0 [2], remains remarkably similar to the steps described by von Moltke. Current operational and exercise planning processes consist of a finite number of steps, none of which are currently automated. In addition, the steps differ slightly in the Navy Planning Process and Marine Corps Planning Process, but remain essentially the same. The process can be summarized as follows:

A Combatant Commander (or other senior officer) offers guidance and a mission statement at the strategic level. This is the Commander's Intent. A Commander then gathers large groups of specialists from among his or her own staff and subordinate units to receive guidance and begin planning. These specialists will organize by staff sections (J3 = Operations; J4 = Logistics; etc.) or along operational functions (C2, intelligence, fires, movement and maneuver, force protection, and sustainment). These specialists work in their respective domains while at the same time coordinating across domains to conduct a thorough mission analysis, develop possible courses of action (COAs), analyze, compare and ultimately recommend one of the COAs to the Commander. Once the plan has been approved, a detailed order will be generated with specific instructions for each aspect of the mission.

The JOPP is completely manual in its mechanisms (see Figure 1). The entire JOPP can be executed without the use of a single computer. Possibly, the most computationally intensive process required is a Microsoft PowerPoint presentation for the Commander to receive the COA briefs. The JOPP also requires gathering many people from many different organizations (often with differing and competing interests) for a long period of time. In the fiscally constrained environment in which we live and operate, this process translates to elevated travel budgets, more time away from other duties and overall inefficiency.

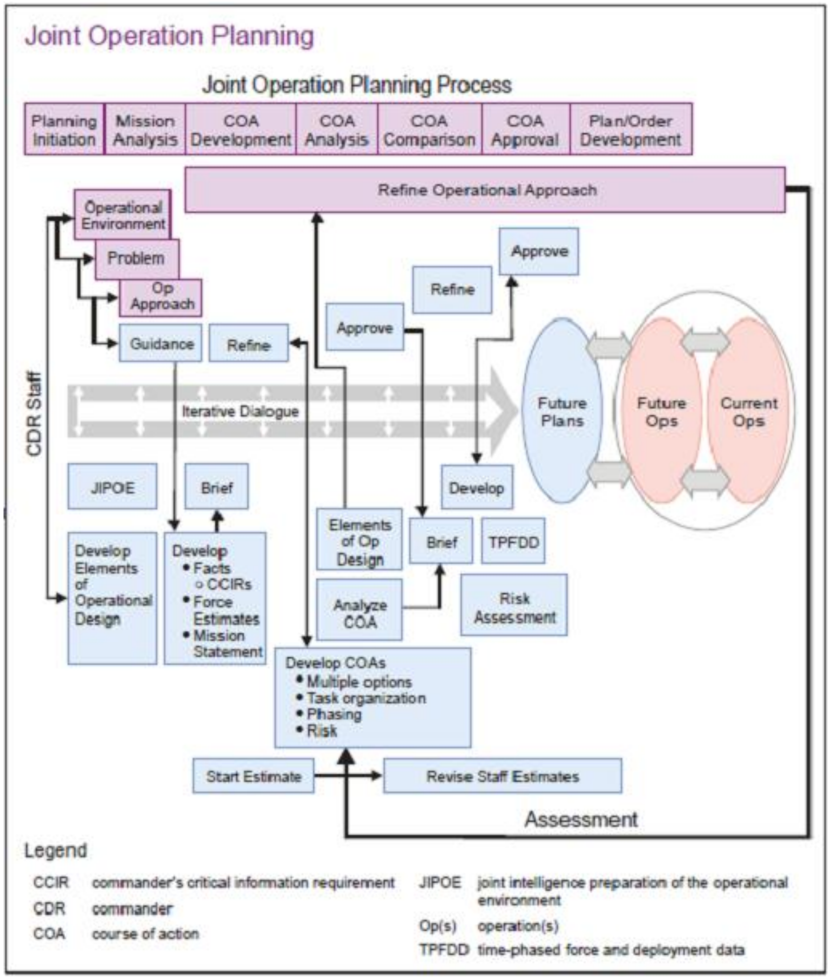


**Figure 1: Joint Operation Planning [6]**

Despite the obvious complications and difficulties the JOPP presents, it has remained essentially the same for generations. The reason this process has not yet been automated is current models do not support a key aspect of the entire planning process which is the notion of iterative dialogue. The dialogue needs to be conducted face to face between subject matter experts (SMEs) throughout stages one through five of the JOPP. If it does not occur, each section will be planning in a vacuum and could possibly move forward on faulty assumptions.

An example helps elucidate the JOPP shortcomings. Consider an amphibious force planning an opposed landing on a hostile beach. This planning team will consist of Navy and Marine Corps planners from a variety of backgrounds. There will be experts from the Surface Navy, Aviation, Mine Warfare, Logistics, C2, etc, as well as Marine Corps SMEs for Aviation, C2, Logistics, Ground Maneuver Elements, and Intelligence all planning together to determine a proposed scheme of maneuver for all units involved in the execution of the amphibious landing. This group will determine a workable plan based on input from each SME. However, if one party is not available or unable to share information, then the plan could completely fall apart.

Within our example, the fires section who is responsible for delivering ordnance to targets plans on employing 100 bombs per day to achieve their desired results. However, if the supply section can only provide 80 bombs per day, then the Commander Landing Force (CLF) will need to change his scheme of maneuver and slow his advance based on the slower rate of ordnance delivery causing the entire plan to be reassessed. The example highlights the fact that all planners must maintain situational awareness of what planning factors present limits for each staff section.

In today's fiscally constrained environment, commanders are more likely to use computer-aided exercises (CAX) than live exercises to rehearse existing operational plans (OPLANS) and to conduct battle experiments in order to determine more effective and efficient avenues to carry out their missions. The future of military training including military planning is in the digital field [3]. The future JOPP must provide military planners and trainers with the ability to train in an effective way so that they are ready to face the challenges of the future. The elements must be broken down and approached so that software can capture key elements of the planning process and present them to a user in a familiar fashion.

In this paper, we propose an approach to enable exercise and operational planners to rapidly develop and assess scenarios that will serve the warfighter and training audiences equally well. This Scenario Development Tool (SDT) serves as a domain-specific interface to existing military simulations. It offers the warfighter and training audiences: (1) a familiar means to specify planning constraints (discrete and continuous) and (2) the ability to visualize the effects of applying the specified constraints to the simulation via response surface. More specifically, this tool will use an interface to define plans and orders that will be sent to modeling and simulation (M&S) systems for execution.

## Specifying Planning Constraints

There are two classes of planning constraints that can be specified in the SDT: *controllable factors* and *uncontrollable factors*. *Controllable factors* describe variables over which a commander has some degree of control (e.g., force composition, readiness, logistics). *Uncontrollable factors* consist of environmental conditions (sensors, terrain, weather), adversary forces (composition, location, readiness, willingness), and neutral / local population (pro U.S., anti-U.S., neutral).

An integral part of this tool is the customized interface. The user (an operational planner or a trainer) will be able to customize all inputs in an intuitive fashion. All input variables (both discrete and continuous) will be represented in a simple, user-friendly, manner, allowing for any user to be able to use the SDT from the day of delivery [4]. A simple, intuitive interface allows for dramatically shorter periods in which the user must be trained on the SDT. Most planners are familiar with Microsoft Windows and Office products; therefore, it is preferable to borrow from the functionality in those product lines rather than creating a new interface from scratch. By using a layout similar to Figure 2 and then allowing the user to choose via radio buttons and sliders the specific variables they wish to examine, the training time for a new user of the SDT will be drastically reduced.

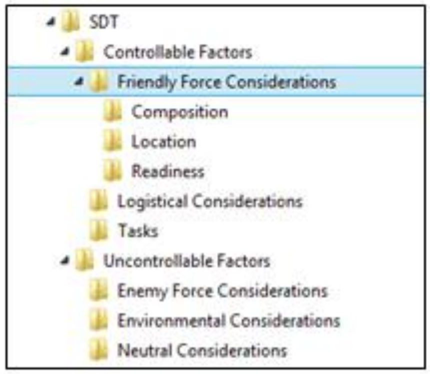


**Figure 2: Sample Folder Structure**

Planners currently use a variety of software programs when conducting detailed planning. They frequently use Microsoft Office products, such as Excel, Word, and PowerPoint to create a central database for data. As plans change and adapt, however, version control becomes a serious issue, with one group working on old assumptions while other groups have moved on to the next issue. The SDT interface should include access to and storage for these files and allow multiple users to access them and make changes while keeping track of current and previous versions. Another collaborative tool must also be included. A chat server allows users from any location to interact and share information in real time. Defense Connect Online is an existing program that allows users to connect via video, audio, and/or text. The SDT should leverage this program to allow users to collaborate in real time. Without this capability, all planners must be co-located so that they can share the required information to make the plan.

Once the constraints are specified and a plan is formulated, we can use the following simulations to execute it:

- One Semi Automated Forces (OneSAF): OneSAF supports military combat training, experimentation, and weapon systems acquisition from the troop-level to the command level. It features the replication of solider fatigue, terrain obstacles (i.e. trees), and limited line of sight due to weather conditions. While OneSAF is not an analytical combat model by design it is HLA and DIS compliant and enables weapon systems to be parameterized with data generated from line-level engineering models.

- Combined Arms Analysis Tool for the XXIst Century (Combat XXI): Combat XXI is a flexible, high resolution, accredited, analytical combat model. It can be used in air defense, artillery, dismounted infantry and combined arms studies to assess the performance of weapon systems within the context of a simulated operational plan. In similar fashion to OneSAF, Combat XXI enables the engineering of weapon systems to be parameterized.

It is possible to use other simulations and in fact we need a flexible architecture that would allow us to plug any simulation as needed. The SDT uses the coalition battle management services (CBMS) [5] as the link between the interface and the simulations. We also rely on the Military Scenario Definition Language (MSDL) [6] as a standardized language to describe the static aspects of the plan (terrain, force structure, weather) and the Coalition Battle Management Language (C-BML) [7] to capture tasks orders and reports that flow between the SDT and the simulation.

An extension to the C-BML schema has been added to support three new report types: advertisement, discovery and alert. An advertisement report lists the entity types a CBMS client is capable of creating. A client posts this advertisement when it is initialized to inform other subscribing clients of its supported entity types. This information may be used by subscribing clients for the generation of an initialization file, such as a MSDL file. A discovery report is generated when an initialization file is received by a client. It lists the valid activity codes that may be assigned to each supported entity type read from the initialization file. This activity code list may then be used by subscribing clients to generate a task file. An alert report is a list of internal warnings and errors raised by a client, such as a fire task failure because an entity is out of range. This report includes the alert message, severity, and the source of the alert.

It is important to note that we can also focus on specific aspects of planning by examining the effects of introducing future capabilities into the planning process. For instance we can use the framework for assessing cost and technology (FACT) to specify the design of a future system, introduce the future system into a plan and use a simulation to execute the plan and compute potential effects. This will give decision makers the capability to objectively assess the performance of potentially tens of thousands of system designs.

## *Response Surface Visualization*

Recall, the goal of the SDT is to enable planners to quickly develop and assess plans. The SDT takes a novel approach to achieving this feature by employing simulations which enable planners to explore the effects of their specified constraints. The goal is to provide a usable, automated means for planners to determine the sensitivity of key scenario outcomes in response to their specified constraints. The SDT realizes this through a response surface. The input variables visualized in the response surface reflect the planner's specified constraints while the output variables (key scenario outcomes) are limited to what the simulation can track and are based on what commanders and planners will likely desire to assist in their decision making. Examples of key scenario outcomes that can be visualized include: resources remaining (ammunition, fuel, etc.), attrition (friendly, hostile, and neutral), break-through value [8], and a collateral damage rating (See Figure 3).

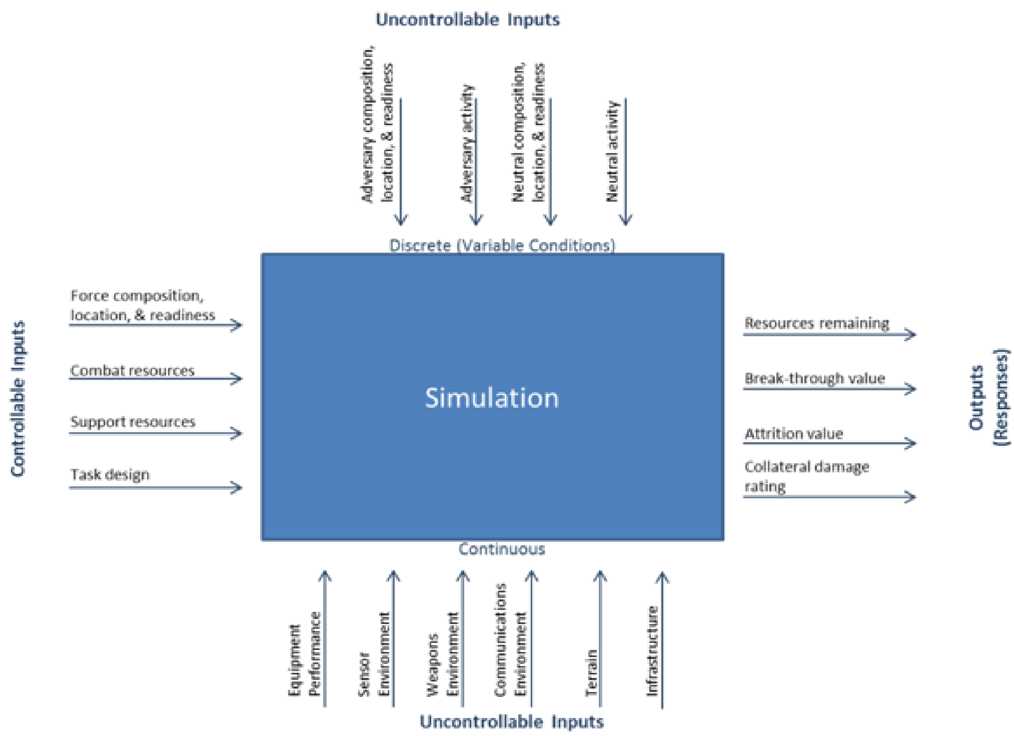


**Figure 3: Inputs and Outputs**

## *SDT Limitations*

While our approach and the SDT demonstrate a great leap forward in scenario development and testing, it also presents some serious limitations. Since the SDT is an interface to an existing simulation, the visualized response surfaces are only as reliable as the employed simulation. In order to produce valid data, the simulation must be able to process and adapt to a variety of variables. Therefore employing simulations with adaptive intelligence capabilities, through human interaction or artificial intelligence is required. Failing to use an "intelligent" simulation will not account for the adaptations that an actual user will make to adjust to the current set of variables and could result in invalid response surface data. Another simulation-related limitation of the SDT is that it currently does not support stochastic simulations. Within the planning community it is prudent to account for multiple possibilities when assessing a plan. The SDT, as currently conceived, allows the user to specify planning constraints, but does not allow for a stochastic deviation from the selected inputs. This is especially useful in environmental, opposing forces, and neutral forces categories. Finally, the SDT must be customized for each underlying simulation since different simulations reflect a variety of different interoperability levels [9]. The variety of simulations and interoperability increases the expense of the tool by requiring programmers to customize the interface between the SDT and the underlying simulation.

## *Company Example*

In order to elucidate the capabilities of the SDT, we applied it to a case study scenario. In the case study scenario, a company sized formation of tanks is charged with taking possession of a home (Oscar 1) that is occupied by enemy combatants. The company consists of two tank platoons, one U.S. Army and the other French Army.

The Company executes a series of tasks in order to achieve the commander's desired end state. That end state is possession of Oscar 1 by friendly forces. The tasks executed by the Company are:

1. Move to a secure area and place a device monitoring Oscar 1.
2. Move along a discrete path to a location close to Oscar 1 to settle in for an assault.
3. Assault and clean the enemies at Oscar 1, seize possession of the house.
4. Fall North of Oscar 1 and install a monitoring device to the North, West, and East of the seized location.

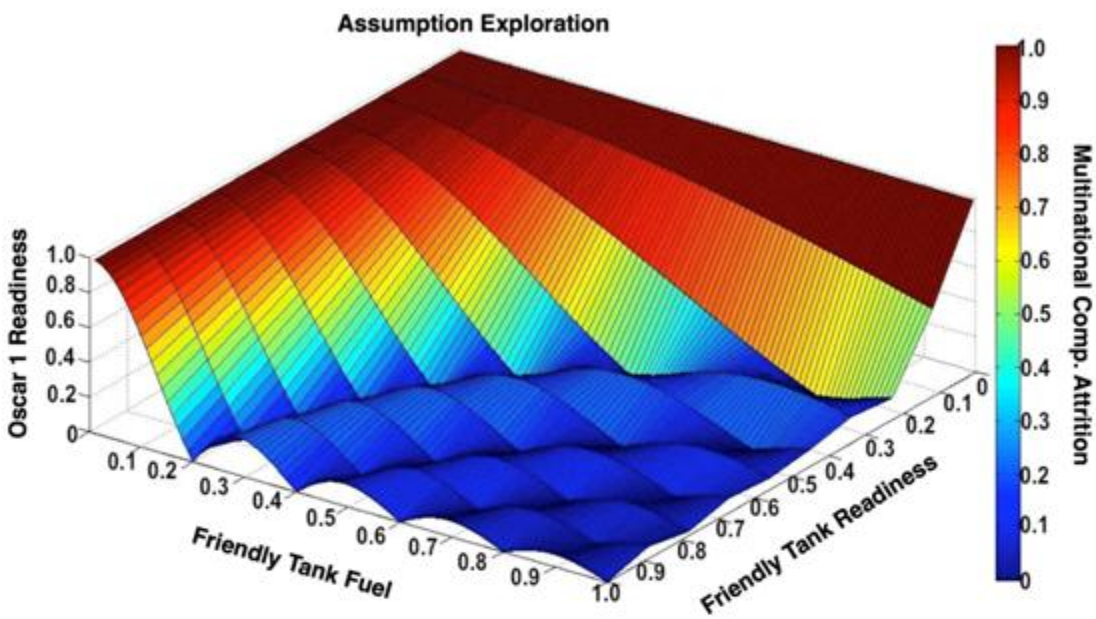


**Figure 4: Sample Response Surface**

Suppose the Commander of the Company wanted to conduct battle experiments to determine the minimum resources and training levels required to achieve his goals while keeping friendly attrition levels at a minimum. Using the SDT, they could experiment with varying readiness levels for friendly and enemy forces as well as the initial level of fuel for friendly forces. These input variables are samples only. The commander could choose any number of resources to track as long as the underlying simulation has the ability to track them. These input variables would be chosen in the SDT and a resulting response surface would then be presented. The simulation(s) (in this case OneSAF) executes the scenario for the specified experimental conditions. The resulting response surface is shown in Figure 4. It is merely for the purposes of this case study and does not represent actual data. Since the SDT hides the simulation from users there is no need to spend computational time visualizing the execution of the simulation(s). The result is nearly immediate feedback to the user creating a framework where they can efficiently experiment a variety of conditions to determine optimum values for successful training/planning.

## Conclusion and Future Work

The SDT we present here is an initial step in a much larger process of meeting the challenge of using computer simulations in support of planning. Ultimately, the SDT has the potential of being the tool that enables a more rapid development, review, and refinement of plans. Future development of the SDT lies in making it compatible with a variety of simple simulations run in various programs and then using it to develop more complicate and detailed scenarios. Both of these avenues of approach must be followed concurrently to support development of a tool that will be useful to all planners.

A key limitation of the SDT is that it must employ an existing simulation. During plan development at the operational level, there is rarely an existing simulation upon which to use the SDT. Thus, in order for the SDT to be effective, the planners must program a simulation of their always–changing plan. However, use of the SDT repeatedly by each staff section or mission area can guide planners towards the most efficient use of limited resources. Additionally, the future SDT will provide the ability for planners to interact via video, audio and text chat allowing planners to conduct their "iterative dialogue." It is easy to envision a future where planners will have the ability to use the Commander's Intent, a list of available resources, and the SDT to rapidly develop, review, and refine a plan. The goal of the SDT development team is to make this future a reality in order to support the warfighters and allow them to use the minimum resources necessary to achieve success.

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