Large Scale Complex Simulation Planning

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ABSTRACT

Battlefield complexity has increased dramatically in recent years. Simulation of large scale maneuvering and troop engagement such as those which occur in military action requires the interaction of large numbers of troops with a wide variety of friendly, neutral, and enemy roles. In order to fully prepare units for combat, considerable effort needs to be expended to set up realistic battle scenarios and engage in simulated combat exercises. This paper describes planning, preparation, and setup required for a Joint, Interagency, Intergovernmental, and Multinational (JIIM) simulation scenarios such as those conducted at the United States Army's Combat Training Centers (CTCs) at Fort Irwin California, Fort Polk, Louisiana, and Hohenfels, Germany. The setup includes planning for the unit in training, planning for exercise setup, and planning for the simulation tools required to produce a truly realistic learning situation.

ABOUT THE AUTHORS

Rick Stikkers has been supporting the Army's Combat Training Centers since 1998. He worked for Raytheon at Fort Irwin and the National Training Center (NTC) from 1998-2005 in increasing positions of responsibility. His last position was as the Engineering Manager. He then moved to the Program Management Office in Orlando where he continued to support the NTC but also supported the Joint Readiness Training Center (JRTC) at Fort Polk, LA and the Joint Multinational Readiness Center (JMRC) at Hohenfels, Germany. He currently serves as the Technical Director for the Warfighter Field Operations and CUstomer Support (FOCUS) contract, supporting all the Army's Live, Virtual, and Constructive training.

Julie Kent has been working in systems integration for over 20 years.   She moved to Raytheon in Orlando nine years ago and programmed a TENA interface for the Instrumentation System at the National Training Center (NTC). Julie worked database upgrades and integration in support of training exercises at the NTC, Joint Readiness Training Center (JRTC) and Joint Multinational Readiness Center (JMRC). She moved on to integrate COTS products to create a management information system that supports cross platform work ordermanagement and life-cycle support.   Shecurrently serves as IT manager for the Warfighter Field Operations and Customer Support (FOCUS) contract, supporting Live, Virtual, and Constructive Training.

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INTRODUCTION

The scope and complexity of missions that nations expect their ground troops to perform has increased dramatically. Previously, ground troops were only required to perform force on force missions, and the majority of training was conducted on pristine battlefields without the complexities of civilian populations, news media, and other realities. Modern troops are now expected to perform force on force missions, but their focus has also expanded to include Joint, Interagency, Intergovernmental, and Multinational (JIIM) missions. The new missions that ground forces face are very complex. They require detailed planning and execution in order to ensure they are performed to standard. The consequences for not getting these missions right is very high. With the constant media attention now focused on how nations conduct war, even the smallest mistake becomes headline news. In order to execute these missions to standard, military training has undergone significant changes. Simulation systems now must incorporate these battlefield complexities in order to ensure that troops are fully trained. Simulation systems which keep up with the new battlefield complexities and its planning cycle are used continually. Simulation systems which do not keep up with the modern battlefield are declared irrelevant.

In order to ensure its troops are fully trained for any eventuality, the United States Army established three Combat Training Centers. It placed the National Training Center (NTC) at Fort Irwin California, the Joint Readiness Training Center (JRTC) at Fort Polk Louisiana, and the Joint Multinational Readiness Center (JMRC) at Hohenfels Germany. These centers are highly resourced and provide the best ground force training in the world. The training events that take place at these centers simulate actual battle conditions including many of the complexities of modern warfare. In many cases it is stated, "Everything is real except the bullets." Since real bullets and real explosives are not used, an instrumentation system is used to track where targets are hit and where explosives including improvised explosive devices result in damage to offensive and defensive forces. This system must track where all of the players in a large exercise are positioned and how a device might impact their functioning. Preparation for this tracking means that all players need to have a tracking device and the instrumentation system needs to be of sufficient scale to track the region where the exercise will take place.

Given that the CTCs conduct exercises with hundreds and at times thousands of players, significant advanced planning is required to outfit all of the players, vehicles, and other equipment. Planning is also required to ensure the Instrumentation System is prepared to track and simulate the different effects that can be expected during the exercise. Although the planning cycles for each center varies somewhat, they follow similar processes. This paper outlines the general planning cycle which the CTCs use in order to ensure units are ready for training. Emphasis is given on the technical coordination required at each stage in order to ensure that the simulation systems are in place and ready for the training event. This paper also outlines the technical coordination required in order to ensure that all of a unit's capabilities are replicated in simulations.

COMBAT TRAINING CENTER MISSION

The US Army established the Combat Training Centers in order to provide the most realistic training possible for brigade sized elements. Two to five thousand soldiers train at a time in very large force on force exercises. The brigade in training goes against a professional Opposing Force (OPFOR) in order to provide the most realistic training possible. The training is planned and overseen by a professional cadre of Observer Controller Trainers (OCT). The OCT force is composed of highly successful personnel who have already commanded at the level that they are assigned. For a soldier to be assigned as a Company level OCT, that person must have commanded a similar unit and successfully completed that command with high ratings from their chain of command. In order to

record everything that happens, the CTCs are outfitted with a complex and high tech package of instrumentation. The goal of this instrumentation is to accurately replicate all of the capabilities that the unit has. Instrumentation also replicates the units that are adjacent and higher in order to provide proper inputs into the unit's command and control systems. The instrumentation also records the actions that the unit takes so it can be analyzed and played back in an After Action Review (AAR). The AAR is the most important outcome of the training. In the AAR, the commander learns what his unit did well, what they need to improve on, and techniques in how to improve performance. For units preparing to deploy, this training is tailored to the specific situation which that unit will see in theater. Once a unit successfully executes the training event, they receive their Title X certification which documents their readiness to deploy to a combat zone.

The Instrumentation System (IS) which supports this training is a very highly evolved simulation system. The core of the Instrumentation System is the Multiple Integrated Laser Engagement System (MILES). MILES is a laser based simulation system which replicates all direct fire weapons systems. Laser sensors on the target detect when a weapon is fired and determine whether the player was killed based on weapon type and laser energy. The results of the engagements along with the position of all players are sent to the Core Instrumentation Subsystem (CIS) for display. The CIS then takes data from all of the systems in the field and combines it for a consolidated display. Video is also collected from the field and combined with the instrumentation data in order to form a complete picture of what happened. These instrumentation feeds are then compared to the tactical systems so the analysts can compare what the unit believes is happening to what is truly happening. The comparison of plan versus what the unit thought was happening versus what was really happening is then presented as the After Action Review.

Another function of the Instrumentation System is to accurately stimulate all the unit's tactical systems. In actual battle units receive reports from adjacent units and also get feeds from capabilities that higher headquarters have. The Instrumentation System creates this larger picture that the unit will be a part of in a large scale deployment and feeds information to the unit just like they will see it in combat. The Instrumentation System also determines the cultural interrelationships which exist in the real world. It maintains the current status of players as to whether they are friendly, enemy, or neutral.

In addition to the instrumentation system, there are people performing the roles of observer/controller. Their task is to view and assess what the unit could do differently at points during the exercise. They note where tasks are performed proficiently and where there is room for improvement. They also track how well the unit wins the hearts and minds of the people and the effects that will have on intelligence. For example, if a commander is able to properly determine who in a village is influential and is able to provide them with proper nation building assistance, that unit gains valuable intelligence as to who is the enemy and gains assistance in how to effectively neutralize that enemy. If the commander does not treat the locals properly, they remain neutral or become hostile.

ROTATIONAL EVENT PLANNING

Unit exercises at the CTCs are called rotational events as units throughout the military take turns rotating through the CTCs prior to going to combat. Planning for each rotational event involves detailed work. The key to success is a spiral process which starts early and is continually updated. There is tremendous effort expended to ensure that a rotation goes correctly. However given the number of personnel involved and the cost of a rotation, the planning costs are very worthwhile. The end result is an extremely realistic scenario which prepares troops for what they will see in combat.

In order to develop an exercise with all the complexities required at a CTC, the Army has developed a comprehensive planning cycle. This planning cycle ensures that the CTC gains a full understanding of the commander's intent for the training exercise and is able to execute that intent. In order to execute that intent, the Instrumentation System is analyzed and modified as necessary in order to support the training event. The inclusion of the technical component of the Instrumentation System is integral to providing the best possible training to the soldiers. To provide sufficient interaction between the units and the staff of the CTCs, rotation planning includes a series of formal events and many less formal communications. An overview of the planning timeline is shown in Figure 1.
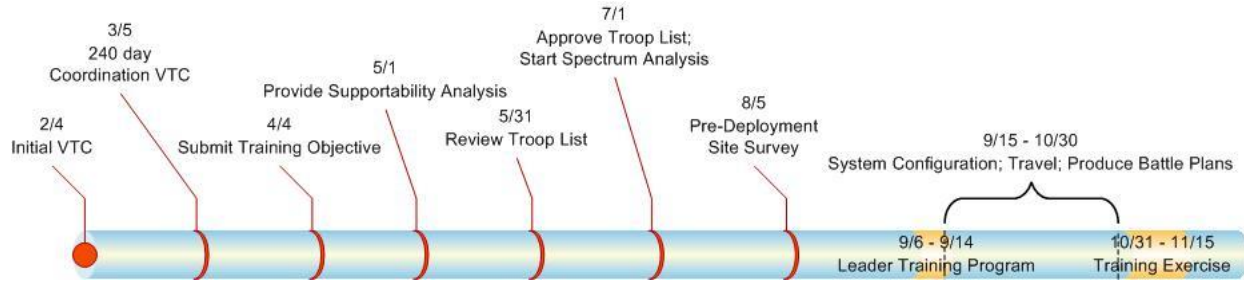
Figure 1- Planning Timeline

The formal planning cycle starts 270 days before the start of the simulated combat exercise. At that point, there is a Video Tele Conference (VTC) between the senior trainer and the commander of the unit to be trained. The main purpose of this VTC is to establish the overall training objective. As part of the training objective, the discussion includes the types of units that will be allowed in the training exercise. Many times units have multiple types of support elements which are attached to them for a deployment. Determining which of these elements would be attached in order to achieve the training objective is important to determine early so each element has time for proper planning.

Once the unit list is agreed upon, the Instrumentation Chief obtains a listing of all equipment from the unit which will be deployed to the CTC. The Instrumentation Chief then compares the types and quantities of equipment being deployed to the current Instrumentation System capabilities. A gap analysis is then performed to identify early which pieces of equipment have not been simulated before as well as which pieces of equipment do not have sufficient instrumentation in order to support the size of unit.

A formal Coordination VTC is scheduled 240 days before the start of the exercise to update and continue the work started at the initial VTC. At this point, the CTC has completed an initial assessment as to the technical capabilities which will be available for the rotation. This assessment is presented to the commander and staff of the unit engaging in training so they can gain an understanding of which systems will be fully replicated and which will be partially replicated. This allows the training unit to gain an initial understanding of the full extent of simulation systems which will be employed for their training exercise. This initial coordination is performed early so that the commander has sufficient time to raise any issues a missing or partly replicated capability will create for the unit. This gives PEO STRI time to react to any objections from the commander and jointly work out resourcing which might be required.

The next formal meeting is the planning conference held 210 days before the start of the exercise. The purpose of this meeting is to formalize the training objective and submit it formally to the CTC. This training objective is submitted on a standard form and includes the unit troop list, the troop list exceptions, approved training objectives, unit Mission Essential Task List (METL), and rotational unit worksheet. The Combat Training Center then provides a pre-deployment package to the unit which includes the Rules of Engagement (ROE) and the systems which will be replicated. This information is also sent to Forces Command (FORSCOM) in order to ensure the higher headquarters is fully informed of the training objectives and ensure that it is properly resourced by the Instrumentation System.

The meeting at 180 days prior to the start of the exercise is to provide a supportability analysis to FORSCOM and to the unit. This supportability analysis includes mini maps which show the general layout of the exercise. This helps ensure that the commander and the higher headquarters agree that the training being planned meets all of the formalized training objectives agreed to at the 210 day planning conference. This assessment includes the planning schedule for any gaps in the system. This is to ensure that any gaps will have a solution which is acceptable to the unit and higher headquarters in sufficient time to be ready for the training event.

The meeting to allow FORSCOM to review the troop list is held 150 days prior to the start of the exercise. The review ensures that the higher headquarters agrees on which units will be allowed to train. It also ensures that the simulation system will be adequately prepared to support all of the capabilities that will be trained. There is also an in process review between the training unit and the Combat Training Center. The purpose of this is to ensure that

the unit commander fully understands how the unit will be supported during its training exercise. There is a review of the simulation system capabilities in order to ensure that they fully support the training objective of the commander.

At 120 days prior to the start of the exercise a formal meeting is held to approve the troop list and verify augmentee requirements. Augmentees fill various roles including acting as civilians during the exercise, supplying additional personnel to support the opposing force, and running errands to support the exercise. Another important part of this coordination meeting is to establish contact between the Electronic Warfare Officer from the unit and the Spectrum Manager from the CTC. Modern tactical units have a wide range of frequencies they use in support of their tactical missions. The complexities of the Instrumentation Systems have made them use significant amounts of spectrum as well. One of the basic tenants of the Combat Training Centers is to make the training as realistic as possible. Part of this realism is to ensure they neither help nor hurt the unit's ability to perform their mission. Both are equally important. If the Instrumentation System interferes with a unit's ability to perform its mission, then the training is degraded. Soldiers quickly get frustrated with the inadequacies of the training and it quickly becomes a distractor. Training is also degraded if the Instrumentation System assists the unit. For example, if the IS contains repeaters which would not be present in a tactical scenario, then the unit is not forced to provide their own repeaters and they get a false sense of confidence. This can translate into negative training as well because the unit is not forced to consider all of the complexities they will face in combat. If the unit is allowed to overlook a need in training, they are prone to also overlook this need in combat. This could prove fatal in a combat situation. Therefore in order to remain neutral, the CTCs to go great length to ensure they do not interfere with unit equipment. Much of this coordination is completed by the Spectrum Manager in order to ensure that the unit's systems are deconflicted with the Instrumentation System. This coordination is a very detailed process which starts at the 120 day meeting.

The Pre-Deployment Site Survey (PDSS) at the CTC occurs 90 days prior to the start of the exercise. The purpose of this meeting is to kick off the detailed near term technical planning for the exercise. Unlike previous meetings which could be done using video teleconference this meeting involves travel. The CTC sends MILES experts to home station in order to train the unit on how to use the simulation equipment which will be placed on its vehicles. At the CTC, the unit staff is introduced to the simulation equipment which will be supporting its rotation. The CTC and the unit trade specific information on versions of software in order to ensure that the CTC matches the versions of tactical software which the unit will be using. The CTC also shows the training unit the feeds they will be receiving from the simulation equipment in order to ensure their adequacy. There is also detailed planning on the networking side in order to ensure that the IP schema will work once the training unit arrives. The CTC also determines how it will monitor the unit tactical communications to include digital and voice. Coordination is made to ensure that the digital communications can be captured by the CTC and sent back for processing. Additionally, the voice communications plan is exchanged in order to ensure that the CTC can capture all voice communications during the rotation. The level of planning for this event is very detailed and outlines very specific methodologies for connecting the networks in order to ensure that the CTC can monitor all the traffic it needs to while still maintaining the integrity and security of the unit networks.

Finally, at 60 days prior to the start of the exercise the Leader Training Program (LTP) begins. LTP is an 8 day exercise designed and resourced to simultaneously train a brigade staff, its subordinate task force/battalion staffs, and ground maneuver company commanders. This is a full rehearsal for the unit at the staff level. Although it is conducted with different equipment than will be used during the rotation, it is still a good opportunity for the staff to see how the simulation equipment will feed into the tactical equipment. It is also an opportunity to ensure that the versions of software are compatible and will work during the exercise. This is also a full dress rehearsal for the simulations in order to ensure that the unit is properly modeled and also that the enemy forces that the unit will be facing are properly modeled. This rehearsal with the staff prior to troops being on the ground is crucial to ensuring that the staff is properly prepared for the exercise as well as ensuring that the simulations are properly configured to meet the unit's training objective. Any lessons learned in this exercise are transferred to the rotational cadre in order to ensure that the live rotation is as realistic as possible.

The remainder of the time prior to the exercise is dedicated configuring the tactical and simulation systems In accordance with the plan. Simulation systems are loaded with rotational unit data, OPFOR data, and simulated data. As the Operations Orders are finalized, detailed battle planning is completed in order to fully execute the rotational construct.

EXERCISE EXECUTION

Exercises at the Combat Training Centers typically last approximately four weeks. The first week of the exercise is called Reception, Staging, Onward Movement, and Integration (RSOI). During RSOI, the unit trains as if they were going into a theater of war. They receive their equipment both from the rail head as well as from prepositioned equipment. They build combat power and prepare their equipment for war. In addition to the tasks that a unit would normally take to prepare for war, they also have to prepare for simulation. This means installing MILES, performing communications checks with the Combat Training Center Instrumentation System, and ensuring their task organization is properly inputted into the system. The Combat Training Centers employ planning cells which replicate higher headquarters, Opposing Forces, and adjacent units. These planning cells employ the same techniques for battle planning that are employed by the rotational unit. The Operations Orders which these battle plans produce are loaded into the simulation systems, and both the enemy and friendly adjacent units are simulated by Combat Training Center personnel using simulation systems.

After the unit has successfully prepared for war, they move into the maneuver box. This movement is a carefully planned event designed to move the combat force from a relatively safe cantonment area through a potentially hostile area into a combat zone. Many disruptions can potentially happen during this time in order to stress the unit the same way they will be stressed during actual combat. The unit then spends two weeks in a simulated combat situation. Many soldiers say after a rotation if they picked the 14 worst days during a yearlong deployment and put them back to back, it would be equal to a Combat Training Center rotation. This intense training period is designed to stress a unit as far as possible in order to prepare it for combat. Units which are performing well are stressed very hard while lesser performing units are not stressed as much. However it is always designed to make the unit a much more capable fighting force after they leave the Combat Training Center than when they arrived. The end result is soldiers providing feedback such as that they died many times in the simulated CTC environment which allowed them to learn valuable lessons which allowed them to remain alive during real combat.

At the conclusion of the training period, the unit comes back to cantonment for Between Rotation Days (BRD). This is the period where they clean and disassemble their gear and prepare to redeploy. Any prepositioned equipment the unit drew is returned and any equipment brought from home station is put back on the rail head in order to take its journey back to home station. This successfully concludes the unit's rotation and they return to home station a much better trained fighting force.

GENERAL INSTRUMENTATION SYSTEM PLANNING

In addition to the planning required for each individual rotation, there is also a tremendous amount of planning required to ensure that the system stays current with changing training needs. The Combat Training Center Instrumentation Systems are complex entities which must continually be maintained and upgraded in order to stay relevant. This section describes the processes by which the CTCs manage their instrumentation systems in order to keep them in peak performance.

Any gaps in capabilities that are determined during exercise planning are escalated to the Program Executive Office for Simulation and Training (PEO STRI). PEO STRI has the mission of replicating the simulated effects of all the capabilities of the training unit. PEO STRI has a large number of contractors who provide the systems to replicate these capabilities. PEO STRI uses its Engineering staff to analyze the gaps and develop a plan on how to close them. When possible, one of the PEO STRI contractors develops a full solution to fill the gap. If that is not possible, sometimes an interim capability is developed. Based on the situation, this interim capability might be completely or partially manual. If the capability will only be deployed to a CTC once, sometimes the interim solution is all the further that the development process goes. If there is a long term need for the capability, the interim capability can be employed until such time as a final solution can be developed and deployed.

The governing body for Instrumentation System planning is the Configuration Control Board (CCB). The CCB is chaired by the Deputy Commander of the Operations Group (DCOG) and consists of voting members from all key areas. The CCB meets on a rotational basis and receives briefings on current status of upgrades, life cycle status of equipment, and upgrades required in order to keep the system relevant. The outcome of the CCB is a prioritized listing of all changes which are approved to be put into the system. This prioritized listing is sent to the various funding agencies in order to find sufficient money to maintain the system.

Like other computer programs, the CTC simulation equipment benefits from regular software updates. These updates consist of bug fixes as well as enhancements. Bug fixes are identified using problem reports. These problem reports are consolidated and prioritized throughout the product line by the CCB. They are then fixed in priority order in order to address the problems with the most impact first. Enhancements are also prioritized throughout the product line. When the Army procures a new type of weapon that weapon's effects and symbol are must be added to the Instrumentation System. After a software update is created, the change is made in the baseline, the change is fully tested in a lab environment, and then the enhancement is applied to the system. Typically software updates are deployed to the CTCs twice per year. This cycle is often enough to ensure that the latest capabilities are added into the system, but not so often that the system is in constant turmoil. If more frequent changes are required to support a specific training event, then they are applied as out of cycle changes.

Hardware preventive maintenance and basic repairs are made regularly between rotations. In addition, hardware systems are constantly monitored for life cycle status . A piece of hardware can reach end of life due to it not being supported by the Original Equipment Manufacturer or because of a high number of failures. End of life dates are projected for all pieces of equipment. As equipment is identified for replacement, it is placed into logical groups for replacement. For example, if an RF amplifier is being replaced, it might make sense to also replace the cabling and antenna that the amplifier is connected to. Additionally, as items are identified for replacement, many times newer technology is capable of performing additional functions so systems can be consolidated and replaced together. Once systems are placed into logical groups for replacement, the proper funding agency forecasts the funding for the replacement then executes the replacement. These replacements are funded and plans are put in place which allow for the replacement of the systems. Replacements are installed and brought on line as they are proven ready to be used for a rotation.

Maintaining the Information Assurance (IA) certification is required in order to keep the system secure and operational. IA patches are applied as a part of the software update process. This allows sufficient time to test all patches before they are applied while keeping the patch level of the system up to date. Routine audits and scans are also conducted in order to ensure that the system is maintained in a secure state. Prior to connection of the IS to any external sources, the systems are checked to ensure they meet the Connection Approval Process (CAP) as approved by the Certification Authority. As long as the CAP is satisfied, the systems are connected in a way which ensures the security and integrity of both systems.

UNIT PLANNING

The final leg of the planning cycle is how the unit plans for the exercise. Although the goal of the exercise is to make the training as realistic as possible, there will always be accommodations which need to be made in order to successfully train in a simulated environment. The first accommodation is that the training objective must be obtainable within the simulated combat environment. For example, if the training objective is to practice rollover drills, the proper selection of training aids is probably not the combat vehicle that the soldiers will be taking into battle. Similarly, there are certain tasks which are not completely replicated at the Combat Training Centers. Ensuring that the unit understands these shortcomings and planning around them is an important part of the unit's training strategy.

It is expensive to deploy units to the Combat Training Centers. Sometimes equipment availability or simulation restrictions force a unit to deploy a different configuration. For example, since it is very difficult to replicate indirect fires in a live training event, the artillery units do not receive as high a level of training as other combat forces. This might make a commander decide to leave some of his artillery forces out of the training exercise because the benefit of the training to that particular unit does not outweigh the cost. Once units are planned, then detailed planning can occur down to the individual pieces of equipment which must be deployed in order to achieve the training objective. For example, Unmanned Aerial Vehicle (UAV) assets are required to be deployed almost exclusively in theater. Therefore their availability for training is very limited. Many times this will cause the commander to employ a virtual UAV rather than a live one. This is the unit's input at the 270 day planning event.

The unit must also understand how to use the simulation equipment. The Combat Training Centers use the Multiple Integrated Laser Engagement System (MILES) as the basis for its adjudication of battlefield effects. Although this system has been designed to be as realistic and transparent as possible, there are still certain aspects of it which soldiers must train on. For example, the MILES system has its own zero which is different from the weapon's zero.

Therefore soldiers must learn how to zero their MILES on top of already having a correct zero on their weapon. The PDSS activities allow the units to learn these differences. There are also many aspects of the Rules of Engagement (ROE) which soldiers must train on. For example, the ROE explains the meaning of different colors of smoke. One color of smoke means that a Family of Scatterable Mines (FASCAM) is in the area. A different color of smoke means that there is a chemical agent which was released in the area. Obviously soldiers need to react differently based on the color of smoke observed. Therefore having soldiers trained properly in which color of smoke means what is essential to ensuring they are trained properly during the event.

If a unit is using this exercise to train for a specific area of operations in war, they will also plan how the enemy they are facing will fight. The Combat Training Centers provide a very robust capability to train in the Joint Interagency Intergovernmental and Multinational (JIIM) environment. However these environments are very difficult to predict and train correctly. It involves modeling the family relationships within villages as well as the leadership of the village. These relationships are developed and modeled by the Combat Training Centers. In accordance with how those relationships exist in the real world, a poor response to a request by one villager might cause fifteen other villagers to turn against the coalition forces. However since that group is enemy to another group, it might cause the enemy group of three villagers to be happy that the other group was not taken care of. Knowing these relationships and which faction that the village leadership belongs to is an important aspect of the training and one which must be planned jointly by both the unit and the Combat Training Center. This joint planning ensures that the unit is trained in a manner which will be consistent with what they will face in combat, but there will be enough unknown elements that the unit will not know exactly what to expect when they perform a mission.Your paper should be no longer than 10 pages. This page limit does not include the title page. Please note that we are changing from a two-column format to a single column format to make it easier to read on tablets.

CONCLUSION

Planning for a large exercise is a very difficult endeavor. It requires intense planning and is a joint collaboration between the tactical unit and both the tactical and technical arms of the Combat Training Centers. When all stakeholders are involved early and often in planning activities, they can work in conjunction with each other to produce a realistic training event which is unrivaled anywhere in the world. Although smaller training events may not require the level of detailed planning required for a Combat Training Center rotation, they can also benefit from the same rigorous process in order to provide their training audience very robust and realistic scenario.